

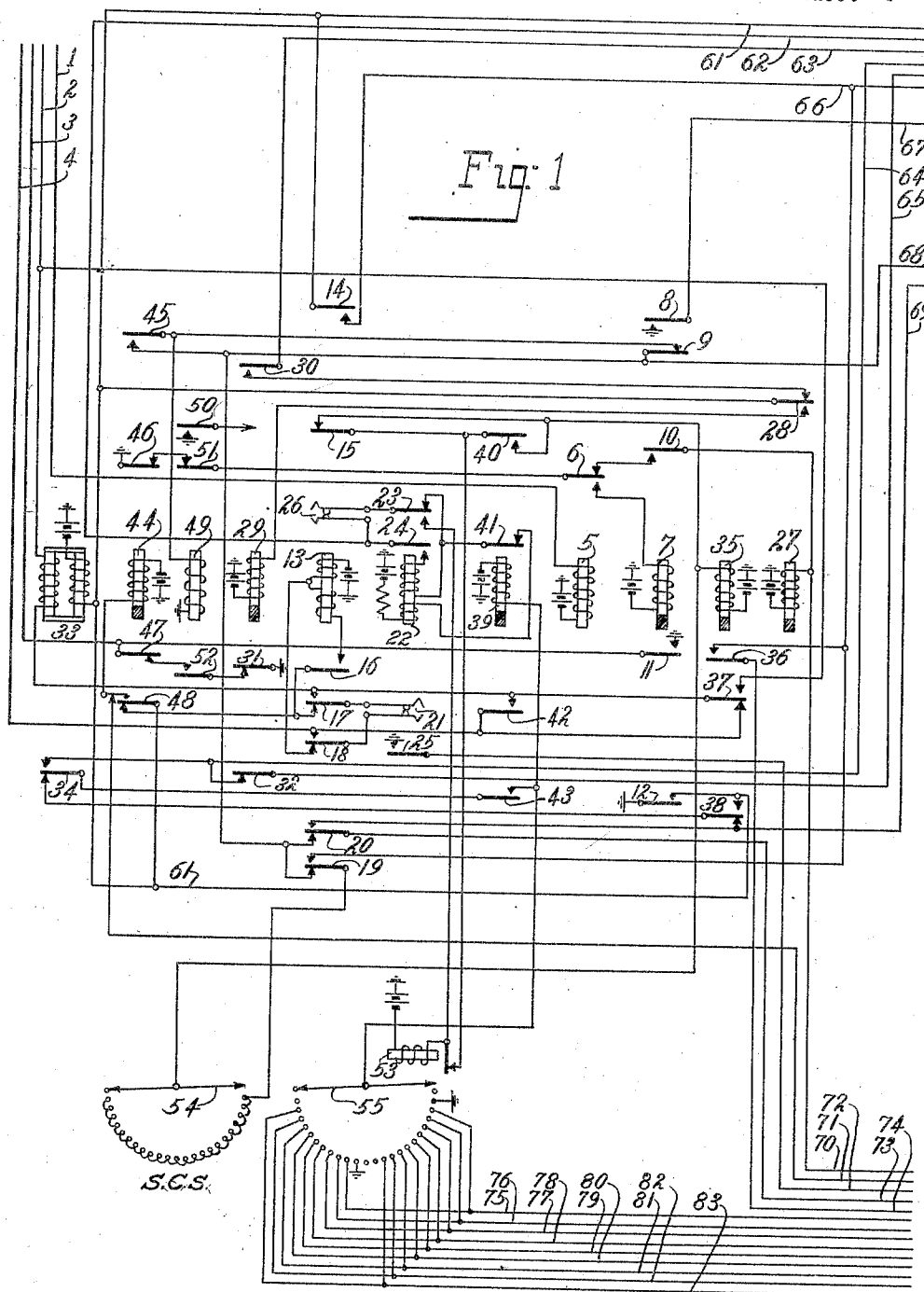
Aug. 13, 1929.

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1,724,142

TELEPHONE SYSTEM

Original Filed Sept. 18, 1926 3 Sheets-Sheet 1



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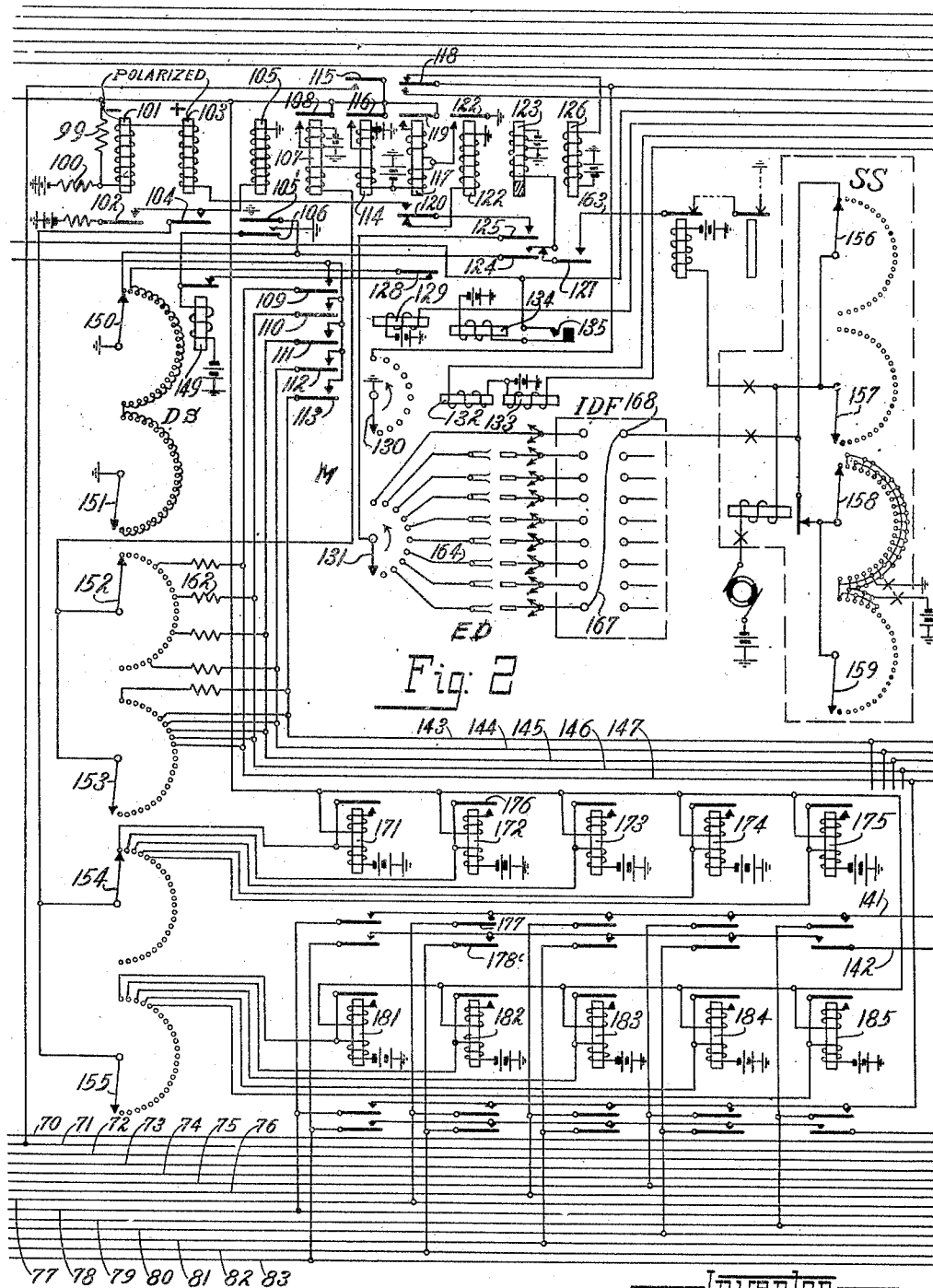


Fig. 2

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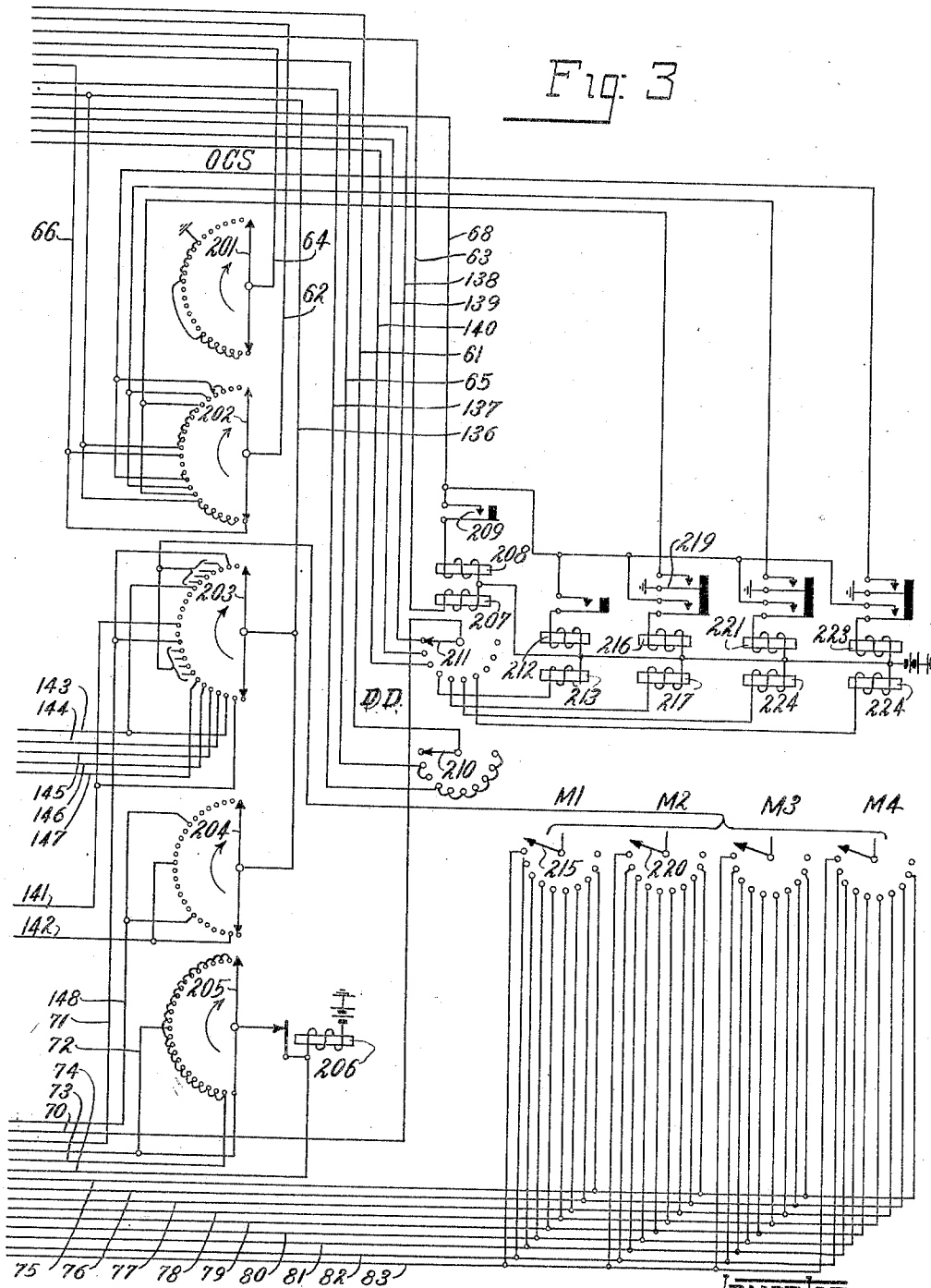
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Original Filed Sept. 18, 1926 3 Sheets-Sheet 3



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UNITED STATES PATENT OFFICE.

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TELEPHONE SYSTEM.

Application filed September 18, 1926, Serial No. 136,212, and in Great Britain June 1, 1926. Renewed January 30, 1929.

The present invention relates to telephone systems and is more particularly concerned with systems in which the number dialled by the calling party is received on a register translator and is subsequently sent out therefrom, the trains of impulses for operating the switches being in general different from those sent in to the register translator.

Register translators may be divided into two classes from the standpoint of the arrangements provided for enabling the exchange digits to be translated. In register translators of the first type, the translating arrangements are individual to the various register translators, while in the register translators of the second type the translating arrangements are common to a plurality of register translators, thereby enabling a considerable saving to be effected and also permitting a change in the routing of calls to be readily made. The present invention is concerned with register translators of the second type.

Broadly stated, the main object of the present invention is to provide circuit arrangements such that the translated digits necessary to route calls to a single office are all transmitted to a given director over a single conductor so as to reduce the number of wipers required on the exchange registering apparatus. This permits a simplified exchange register to be used as will hereinafter appear.

According to one feature of the invention in a telephone system employing register translators, a separate impulse sending device common to a plurality of register translators is provided for each exchange to which connections may be set up.

A further feature of the invention is that in a telephone system employing register translators, one or more trains of impulses representing a complete translated exchange code are adapted to be sent to a register translator from apparatus common to a plurality of register translators.

These features will be appreciated better from the following description of one method of carrying the invention into effect. This arrangement is given by way of example only, however, since it will be apparent to those skilled in the art that the prin-

ciples of the invention are capable of wider application than to the precise arrangements shown.

The invention has been applied to register translators used in a comprehensive multi-office system of a size making necessary the registration of three characters or digits to identify the called exchange. The first digit is registered on a simple type of ten point stepping switch. The digit 1 is not employed as an exchange digit, and the digit 0 alone is used to route calls to a certain operator, leaving only 8 digits that may be used as the first digit of an exchange designation. As a single connection suffices for controlling a given translation, a two-motion office register having eight wipers may be used to register the second and third exchange digits. The switch on which the first digit is registered may be termed the A-digit switch, and the switch on which the second and third digits are registered may be termed the B—C digit switch. The position assumed by the A digit switch determines the wiper to be used on the B—C digit switch, and the position assumed by the B—C digit switch determines the particular bank contact on which the wiper selected by the A digit switch is placed.

As the entire exchange code is transmitted to the director over a single conductor and as the digits must be transmitted one after the other to form the code, the amount of time required for all the digits to be received in the director would ordinarily be so long that a considerable amount of time, relatively speaking, would be lost in the average case while waiting for the starting point in the transfer operation to take place. Furthermore, as the sending apparatus is common to a number of directors it cannot start to send a code to a second director while it is in the middle of sending a code to a first director, and the second director must wait until the transfer of the code to the first director has been completed, at which time the second director and any other waiting directors may be taken care of. It is accordingly a further object of the invention to reduce the waiting time as much as possible by increasing the speed at which the impulses are transmitted. This is secured by

transmitting the impulses to especially sensitive relays in the form of a code containing positive and negative impulses.

Referring now to the drawings, the system there shown is of the general type disclosed in application Ser. No. 755,374, filed Dec. 12, 1924, though differing therefrom in a number of important respects, which will be appreciated as the description proceeds.

Figs. 1, 2 and 3 show only the register translator equipment and it is assumed that this is seized by a non-numerical switch from a trunk relay group somewhat similar to that shown in the specification mentioned, the essential points being that four conductors lead to the register translator, two of which are employed for the sending of outgoing loop impulses; one is the guarding conductor to which earth is connected as long as the register translator is to remain in use, and the fourth is an impulsing conductor over which impulses corresponding to the numbers dialled by a calling party are sent.

Assume that the calling subscriber wishes to obtain connection with a subscriber whose number is Holborn 2345, and that he accordingly dials the digits HOL—2345. When the calling party removes his receiver, his individual line switch hunts for a free trunk relay group in known manner, and the rotary switch associated with this trunk relay group then hunts for a free register translator.

Assuming that the one shown in the drawings is seized, earth is connected to lead 1, and thereupon line relay 5 operates, at armature 6 a circuit is then completed for release relay 7, which extends from earth, armature 46 and its back contact, back contact and armature 51, armature 6 and its front contact, winding of relay 7, to battery. Relay 7, upon operating, at armature 8 connects earth to lead 67 for a purpose which will appear subsequently, at armature 9 opens a point in the release circuit over lead 68, at armature 10 prepares the impulsing circuit, and at armature 11 connects earth to lead 4 to busy the register translator in the banks of the hunting switches having access to it. Moreover, at armature 12, earth is connected to lead 61 whence it is extended to wiper 210 (Fig. 3), to the polarizing winding of relay 33, and also over armature 48 and its back contact, back contact and armature 17, pulse springs 21, armature 18 and its back contact, upper winding of relay 13 to battery. Relay 13 is a two-step relay, and at this time only operates its light armature 16 to prepare a circuit through both windings in series. The above traced circuit is completed when the springs 21 are closed and when next they open, relay 13 operates fully and at arma-

tures 17 and 18 connects springs 21 to the outgoing pulse conductors 2 and 3. Though this has no particular effect at the present time. This arrangement is employed in order to insure that in case the springs 21 should be dirty or not functioning properly, the register translator will be unable to attempt to send out the impulses and instead an alarm will be given. Full details of the alarm circuit are not shown in the present instance, but they are fully described in the application above referred to. Relay 13 at armatures 15, 19, and 20, opens points in restoring circuits for the switches SCS and OCS, and at armature 14 completes a circuit which extends from earth on lead 61, armature 14 and its front contact, lead 66, first contact in the bank of wiper 202 and said wiper, lead 62, interrupter springs 26, armature 23 and its back contact, armature 41 and its back contact, lower winding of relay 22 to battery. The energization of relay 22 is dependent upon the correct operation of the springs 26 in the same way as that of relay 13 was dependent upon springs 21, and when springs 26 next open after the above circuit is completed, relay 22 operates fully over both windings and its light armature 24 in a circuit which does not now include springs 26. Relay 22 at armature 23 transfers the circuit including springs 26 to the magnet 53 of the switch SCS, and at armature 25 completes a circuit over lead 72, first contact in the bank of wiper 205 and said wiper, interrupter springs and winding of magnet 206 to battery. The switch OCS is thus advanced one step, whereupon the above traced circuit is opened and moreover the circuit extending to the springs 26 over wiper 202 is also opened, this operation taking place before these springs again close so that no pulses are sent to magnet 53 at this time.

After the above traced operations have taken place the calling party may dial the first letter H of the wanted exchange name, whereupon four interruptions will be produced in the circuit of relay 5 and this accordingly releases intermittently. Upon each falling away of armature 6, a circuit is completed from earth, armature 46 and its back contact, back contact and armature 51, armature 6 and its back contact, front contact and armature 10, winding of relay 27 to battery, and parallel thereto over lead 70, wiper 211 in first position, lead 138, winding of magnet 129 of the switch M to battery. The wipers 130 and 131 of this switch are therefore advanced four steps, so that wiper 131 is then connected to wiper 164. Relay 27 operates and being slow to release, remains energized throughout the train of impulses and at armature 28 completes a circuit for relay 29 which is also slow to release. Upon the termination of the train of im-

pulses, relay 27 falls away and a circuit is then momentarily completed from earth on lead 61, armature 28 and its back contact, front contact and armature 30, lead 63, winding of magnet 207 to battery. By the operation of magnet 207 the wipers 210 and 211 of the digit distributor DD are advanced one step, so that the succeeding train of impulses over lead 70 is routed over the second contact in the bank of wiper 211 and lead 139.

When the next letter O is dialled, six interruptions are produced in the circuit of relay 5, and six impulses are accordingly sent over lead 170, wiper 211, lead 139 to the vertical magnet 132 of the exchange digit recording switch ED, which accordingly raises its eight wipers six steps. Relays 27 and 29 co-operate as before to advance the wipers 210 and 211 one step upon the termination of the train of impulses, and consequently when the next letter L is dialled, five impulses are transmitted by relay 5 over lead 140 to the rotary magnet 133 of the exchange digit recording switch, which accordingly rotates its wipers five steps.

For convenience of description, the operation of recording the remaining digits, i. e., the numerical digits, will be briefly traced before consideration is given to the sending out process. When the digits 2, 3, 4 and 5 are dialled subsequently, they operate relay 5 and the impulses produced are routed by wiper 211 of the switch DS in turn to the magnets 212, 217 and 224, of the digit registers M1—4, so that the wipers of these switches are advanced to corresponding positions. The moving on of the wipers of the switch DD is effected by relays 27 and 29 as previously described.

As soon, however, as wiper 210 of the switch DD engages the fourth contact in its bank, which occurs on the termination of the third digit in the exchange name, a circuit is completed as follows: earth on lead 61, wiper 210 and its fourth contact, lead 137, armature 118 and its back contact, winding of relay 126 to battery. Relay 126 thereupon operates and at armature 127 connects earth by way of pick-up lead 163 to relay 153. Hence, when earth is next applied to lead 165, relay 123 is operated and at armature 124 locks itself up to earth on the first contact in the bank of wiper 150. The operation of relay 123 also completes the following circuit: earth, winding of relay 121, back contact and armature 120, front contact and armature 125, wiper 131 of the switch M, wiper 164 and the contact on which it is now resting, terminal 166 on the left hand side of the IDF, jumper 167, terminal 168 on the right hand side of the IDF, first contact in the bank of wiper 158 and said wiper, winding of magnet 160, interrupter 161 to battery. Since the winding of relay 121 is

very low resistance, when the interrupter contacts close, relay 121 and magnet 160 are operated in series in this circuit and the former at armature 122 completes a circuit for the lower winding of relay 117, whereupon it operates its light armature 119. When the contacts of interrupter 161 open, magnet 160 deenergizes and advances wipers 156—159 one step. Since wiper 156 now finds earth on all the remaining contacts in its bank, magnet 160 continues to be intermittently energized under the control of interrupter 161 and the wipers of the switch SS are rotated continuously forward until they again arrive at their initial position with results which will be pointed out shortly. The opening of the initial energizing circuit for relay 117 results in the full operation of this relay, whereupon at its armature 128 it opens a point in the homing circuit of the switch DS, at its armature 120 it transfers the connection of wiper 131 from relay 121 to relays 101 and 103 and at armature 118 it opens the circuit of relay 126 and connects earth on lead 137 to lead 136 for a purpose which will be explained subsequently.

It should be explained at this point that the switch SS is not individual to the register translator shown, but is common to the whole exchange as is also the distributing frame IDF; this is indicated by enclosing them in dotted rectangles. The contacts in the banks of the various switches such as ED used for recording the digits of the exchange name are multiplied together and are connected to the left hand side of the IDF, and as mentioned above, for each exchange name which the register translator is capable of dealing with, only a single jumper is necessary on the IDF. A switch similar to SS is provided for each exchange in the system and the difference between these switches consists in variable connections to the banks of wipers 158 and 159. Certain of these contacts are connected either to battery or to earth while others are left blank and these connections determine the exchange code digits to be sent out by the register translator.

The effect of the operation of the switch SS will now be considered in detail. It will be seen that when earth was connected to lead 67 on the operation of relay 7, a circuit was completed from battery to earth by way of resistances 29 and 100 which are preferably of approximately equal value; consequently the potential at the junction point of these two resistances, to which one terminal of relay 101 is connected, is substantially half that of the exchange battery. As soon as wiper 158 is advanced to its second contact, which we will assume is connected to battery, a circuit is completed as follows: battery, wiper 158, terminal 168,

jumper 147, terminal 166, wiper 164, fourth contact in the bank of wiper 131 and said wiper, armature 125 and its front contact, armature 120 and its front contact, windings of relays 103 and 101 to the junction of resistances 99 and 100. Relays 101 and 103 it should be mentioned are polarized and relay 101 only operates with current in a certain direction, while relay 103 only operates with the current in the opposite direction. It will be assumed that with battery connected up as in the present instance, the direction of current flow is such as to cause the operation of relay 101. When this occurs a circuit is completed from battery, armature 102 and its front contact, winding of relay 105 to earth. Relay 105 operates in this circuit and at armature 106 completes a circuit for the driving magnet 149 of the switch DS, which is accordingly energized. Shortly after this, wiper 158 will be advanced a further step under the control of interrupter 161 and when it breaks contact, relay 105 deenergizes and the wipers of the switch are advanced one step. It will be noted that the contact which wiper 158 now engages is connected to earth; consequently relay 103 operates in the circuit previously traced, thereupon completing a circuit from earth, winding of relay 105, front contact and armature 104, wiper 154 and the second contact in its bank, lower winding of relay 172 to battery. Relay 105 operates as before to advance the wipers of the switch DS and relay 172 is also operated, and at its armature 176 completes a locking circuit for itself including both its windings to earth on lead 67. Moreover, at armatures 177 and 178 circuits are prepared for marking contacts in the bank of wiper 55 of the switch SCS to control the subsequent sending operation.

It will be noted that the next two contacts in the bank of wiper 158 are connected to battery, while the succeeding one is connected to earth. From what has been stated above, it will be clear that as the switch SS advances a further three steps, the wipers of the switch DS will be stepped round in synchronism and that, over the fifth contact in the bank of wiper 154, a circuit will be completed for the relay 175 but circuits will not be completed for the relays 173 and 174. Relay 175 upon operating locks itself up to lead 67 and at armatures 179 and 180 closes further points in the marking circuit.

To avoid complicating the drawings, only the first and sixth groups of storage relays are shown, but it will be understood that the small dotted rectangle indicates four other groups of relays similar to those shown. These relays are adapted to be energized over the remaining contacts in the bank of wiper 154 and those shown in the bank of

wiper 155, and then close contacts in circuits extending from the banks of wipers 203 and 204 similar to those shown. In order to give a complete description, it will be assumed that the connection is being set up from a distant exchange and that accordingly six code digits are necessary to extend the connection under consideration to the Holborn exchange, the letters HOL being translated into the digits 260—342. Accordingly when the switch SS continues its motion, the switch DS will continue to operate as long as wiper 168 finds battery or earth. With the translation assumed, the first relay will be operated in the second storage group, none at all in the third group, the first and fifth in the fourth group, and the fourth and fifth in the fifth group. In the last group comprising relays 181—185, relay 182 only is operated and this locks up to lead 67 over both windings in series and at its lower armatures prepares marking circuits similar to those mentioned above.

The switch SS continues its rotation over the remainder of its bank, though in the present case without further useful effect, and if no other register translator in this exchange is waiting to set up a call to the Holborn exchange at the moment, it will come to rest when it reaches its normal position and will only be started up again when the next call is required to Holborn. The switch DS will preferably remain in the position to which it has been set, namely with wipers 151, 153 and 155 engaging their respective sixth contacts, and it will be appreciated that this means that the remaining contacts in the bank of wiper 159 are left dead. Relay 123 is slow to release and remains energized while the switch DS is being operated owing to the intermittent connection of earth over armature 105'. When the switch DS comes to rest, however, relay 123 deenergizes and at armature 125 disconnects wiper 131 to prevent the switch DS being further operated.

Some further description may be given at this point of the storage relays, such as 171—175, which are all of the type known as minor relays. Since it is only necessary for them to operate three pairs of make springs, and moreover they are always energized in local circuits, they can be made of very small size, which has the two-fold advantage that they occupy a very small mounting space, and also that they are cheap to manufacture. It will be seen from the drawing that the contacts controlled by these relays are connected to the appropriate leads extending to the bank of wiper 55 of the sender control switch SCS, and moreover that in case the fifth relay is operated as well as any one of the four other relays, earth will be connected simultaneously at

the appropriate time to three contacts in this bank. This however, does not produce any deleterious effect, for, since the switch SCS is arranged to terminate impulse sending as soon as wiper 55 finds earth, it is of no importance whether the contacts subsequently encountered during the homing motion of the switch are connected to earth or not.

10 The description of the actual sending out operation will now be taken up. When earth is connected to lead 136 by the operation of relay 117, it is extended over the second contact in the bank of wiper 202 and
15 said wiper, lead 62, impulse springs 26, armature 23 and its back contact, armature 41 and its back contact, lower winding of relay 22 to battery. Relay 22 operates partially in this circuit when springs 26 close and when
20 they subsequently open, operates fully, and at its armature 23 transfers the impulsing circuit to magnet 53 of the sending control switch SCS. The operation of armature 25 is without effect at the present time since
25 wiper 205 is now moved off its first contact. When the springs 26 again close, an impulse is sent to magnet 53 which accordingly energizes and on its subsequent deenergization wipers 54 and 55 are advanced one step. A
30 circuit is then completed as follows: earth, armature 12 and its front contact, armature 14 and its front contact, lead 66, front contact and armature 19, second contact in the bank of wiper 54 and said wiper, winding
35 of relay 35 to battery. Relay 35 thereupon operates and at armature 36 completes a circuit for magnet 206 of the switch OCS, whereupon this magnet energizes but does not for the present advance the associated
40 wipers; at armature 37 removes the shunt around the impulse springs 21, at the same time short-circuiting the left hand winding of relay 33 so as to cut this out of the impulsing circuit and at armature 38 prepares
45 a locking circuit for relay 39. In the present instance owing to the operation of relays 172 and 175, earth is extended to the fourth contact in the bank of wiper 55 over the following circuit: front contact and armature
50 118, lead 136, wiper 204 and the second contact in its bank, lead 142, armature 180 and its front contact, front contact and armature 172 and lead 82 to the fourth contact in the bank of wiper 55. It will be seen moreover,
55 that earth is extended over lead 141 and armature 177 and its front contact to lead 77 and over contact and armature 179 to lead 79, but as pointed out above, since these leads extend to contacts in the bank of wiper 55
60 which are encountered subsequently to the contact connected to lead 82, the connection of earth over these leads is without effect.

When the springs 21 and 26 which open and close in synchronism though not in
65 phase, continue their operation, springs 21

serve to produce interruptions in the outgoing loop circuit over leads 2 and 3, while springs 26 serve to send impulses to magnet 53 to advance the wipers of the switch SCS. When two impulses have been sent to the
70 distant switches which are being operated, wiper 55 will be advanced into engagement with the contact connected to lead 83 and a circuit will then be completed from earth on this contact over the wiper for relay 39. 75
Relay 39 accordingly operates, at armature 41 opens the circuit of relay 22, so that this relay deenergizes, at armature 42 shunts the sending contacts 21 so as to prevent further impulses being sent to the distant switches
80 and at armature 43 completes a locking circuit for itself dependent upon armature 32 of relay 35. Moreover, at armature 40 a restoring circuit is completed for the switch SCS from earth on the multiplied contacts
85 in the bank of wiper 54 and accordingly the switch rotates automatically until wiper 54 no longer finds earth. The circuit of relay 35 is then opened also, and it deenergizes slowly, thereby opening the circuit of magnet 206 which deenergizes also and advances
90 the wipers 201—205 one step. Relay 35 also at armature 38 opens the locking circuit of relay 39 so that this relay also commences to fall away. When relay 39 finally releases, the circuit is again completed for relay 22
95 and this is operated by impulses over springs 26 and thereby transfers the pulsing circuit to magnet 53. Consequently the same sending cycle now commences afresh, the only
100 difference being that since the second digit of the exchange code is 6, only the first relay in the second storage group is operated and thus earth is connected to lead 78 and hence
105 to the contact in the bank of wiper 55 corresponding to a train of six impulses, over lead 144 from the third contact in the bank of wiper 203. The sending of the remaining
110 digits 0348 in the wanted exchange code takes place in a similar manner, the switch SCS in each case advancing a number of steps equal to the number of impulses being sent out and being then rotated automatically to its normal position. It may be
115 pointed out that for the sending of a train of ten impulses no storage relays are operated and impulse sending is accordingly terminated by the permanent earth connection in the bank of wiper 55. The switch OCS is moved one step between successive trains of
120 impulses and after the full six digits have been sent out will be in the eighth position in which it is to control the sending of the first numerical digit. Since wiper 215 of the register M1 was advanced two steps in response to the first numerical digit dialled by the calling party, the contact corresponding to a series of two impulses is marked in the bank of wiper 55, the circuit to wiper 215
125 extending over wiper 203 and its eighth con-

tact. The transmission of the remaining numerical digits 345 which are recorded on the registers M2—M4 takes place in a manner which will be clear from what has already been said and this need not therefore be described in detail. It will be noticed that the earth for operating magnet 53 during the sending out of one numerical digit is obtained over off normal contacts of the register which records the succeeding digit so that there is no possibility of the sending out operation tending to overtake the sending in operation.

When the switch OCS is advanced to its twelfth position on the termination of the sending of the last numerical digit, a circuit is completed from earth on wiper 203, lead 71, normally closed springs controlled by armature 48, winding of relay 44 to battery. Relay 44 thereupon operates, at armature 48 completes a locking circuit for itself and opens the circuit of relay 13, at armature 46 opens the circuit of release relay 7, and at armature 45 completes a restoring circuit for the switches SCS and OCS, ED, DD, and M1—M4. Relay 7 thereupon deenergizes slowly and upon releasing at armature 8 removes the holding earth from lead 67, at armature 9 shunts armature 45 so as to maintain the restoring circuit after relay 44 falls away, at armature 12 opens the circuit of relay 44 so that it commences to deenergize and at armature 11 removes earth from the guarding lead 4 thereby effecting the switch over operation at the trunk relay group over which the register translator was seized and preparing to free the register translator so that it may be used in the setting up of another call.

Owing to the operation of armature 45, earth is supplied through the low resistance winding of relay 49 to the bank of wiper 54 of the switch SCS, and also over the lead 73 to the bank of the wiper 205 of the switch OCS.

Moreover, it is extended over lead 68 and off normal contacts 135 to the release magnet 134 of the switches ED and M, and also to the release magnets 208, 212, 216, 221, and 223 of the switches DD and M1—M4 over the appropriate off-normal contacts. Consequently all these switches are restored to normal in known manner and the current flow through relay 49 serves to operate it, thereupon at armature 50 closing a point in the release alarm circuit which is fully described in the specification previously referred to, and at armature 52 re-connecting earth to the test lead 4 so as to prevent the register translator being taken into use as long as any of the switches have not been returned to normal. The relays locked up to lead 67 are released when earth is removed from lead 67 and relay 126 falls away when its energizing earth is removed on the release

of the switch DD. Thereupon at armature 128 a restoring circuit is completed for the switch DS and it returns to its normal position. All the apparatus in the register translator is thus restored to normal and it may then be taken into use for setting up other calls.

It may be mentioned at this point that the polarized relay 33 is provided to hold up the transmission of impulses if necessary in case several nonnumerical switching stages should be included between successive series of impulses. The arrangement is that after relay 35 has deenergized when wiper 54 no longer finds earth, the short circuit round relay 33 is removed and in case the appropriate switch is not yet ready to receive the next series of impulses, relay 33 is operated at this time, and at armature 34 completes an additional holding circuit for relay 39 which extends from the winding of relay 39, front contact and armature 43, armature 34 and its front contact, lead 64 and wiper 201 to earth at one of its contacts 2—7. Consequently until the last hunting switch, for instance, a secondary line switch, has found a free line, the polarized relay 33 remains operated and thus the sending is held up. As soon as the transmission of impulses may proceed, current is reversed over leads 2 and 3 and relay 33 then deenergizes and opens the circuit of relay 39.

A description will now be given of the arrangement provided for moving the switch OCS through the spare exchange code sending positions in case the full six exchange code digits are not required. Suppose for instance that a call is being set up to the central exchange and that the letters CEN dialled by the subscriber are translated into the digits 71. In this case the switch M will be set to a different position, and thus a different wiper of the switch ED will be employed, over which connection will be made by a jumper at the IDF to a common switch similar to the switch SS but differently wired. Since the first digit to be sent out is 7, the effect of this switch will be to operate relay 172 in the first group, and the relays corresponding to 171 and 175 in the second group. This switch SS only has the first eleven contacts in the bank of the wiper corresponding to wiper 158 wired, so that when the switch DS has been advanced ten steps, no further circuits are completed for either relay 101 or relay 103, and consequently no further circuit can be completed for magnet 149. The switch DS, therefore, remains in this position with wiper 152 engaging contact 161. The two exchange code digits 7 and 1 are then sent out in the manner previously described and when the switch OCS advances its third step, a circuit is completed as follows: earth on wiper 203, fifth contact in its bank, lead

144, resistance 162, contact 161, wiper 152, lower winding of relays 107 and 114 in series to battery. Relay 114 is marginal and does not operate at this time owing to the inclusion of resistance 162 in the circuit, but relay 107 operates and at armature 108 locks itself to lead 67 and at armatures 109—113 connects leads 143—147 to lead 69. Consequently earth is now extended from lead 144 over lead 69, front contact and armature 20, lead 73, fifth contact in the bank of wiper 205 and said wiper, interrupter contact and winding of magnet 206 to battery. Magnet 206, therefore, operates to advance the wipers of the switch OCS one step, whereupon a similar circuit is completed over lead 145, so that the wipers are advanced a further step. Thereupon this circuit is again completed over lead 148, and subsequently over lead 147, and the result is that the wipers of the switch OCS are advanced through all the exchange code sending positions into the position to control the sending of the first numerical digit. This operation of course takes place very quickly but in order to prevent impulse sending continuing prematurely, the earth on lead 69 is extended over back contact and armature 38 to hold up relay 39 while this automatic movement takes place. It will be appreciated that this arrangement can be made to serve whatever the number of digits in the exchange code, provided, of course, that this number is not greater than six.

The case will now be considered briefly in which for some reason or other a call is to be trunked to an operator, for instance a toll operator. In this case the called party will probably dial the letters TOL but no numerical digits. The switches M and ED will accordingly be set in the usual manner, and a switch such as SS will be selected, which is wired to transmit the requisite code for trunking the call to the toll operator. In this case, however, a number of contacts in the banks of wipers 158 and 159 following those which are necessary to set up the proper relays in the storage relay groups are connected to battery. Consequently after the switch DS is moved a distance sufficient to set up the proper relay groups, for instance the first three, it continues to advance in synchronism with the switch SS, but since relay 101 is operated in every case, no further storage relay groups are operated. With the assumed conditions, this movement continues until wiper 153 engages contact 163 after which the wipers are brought to rest. The sending then takes place in the usual manner, and after the three digits have been transmitted, earth will be connected over the lead 145 to contact 163 and will therefore be extended over wiper 153 to relays 107 and 114. Since this is a direct earth connection, both of these relays now

operate, although only the relay 114 performs any useful function. This relay at armature 116 locks itself up over its upper winding to lead 67 and at armature 115 connects earth to lead 69, whence it is extended to the winding of the switching relay 44. The operation of the switching relay which now takes place effects the switching through of the connection at the trunk relay group, and the release of all the apparatus in the register translator which may then be taken into use for another call.

One further case remains to be considered, that in which a subscriber wishes to call an operator, for instance for inquiries or the like, in which case it is usual practice to dial only the digit 0 and, as will be appreciated, the effect of a single digit in the ordinary way is merely to set the minor switch M, but not to connect up a switch such as SS, or to start the sending operation. However, the tenth contact in the bank of wiper 131 instead of extending to a wiper of the switch ED as do the other contacts, extends directly to a terminal on the left hand side of the IDF, whence connection is made to a terminal on the right hand side associated with the switch for sending the requisite code for trunking the call to the operator. Moreover, since only the digit 0 has been dialled, it will be of no use waiting for the switch DD to complete a circuit over lead 137 for the starting relay 126. This, however, is taken care of by an additional bank of the switch M, the wiper 130 of which is advanced to its tenth contact when the digit 0 is dialled. A circuit is then at once completed for relay 126 and this connects up the sending switch as previously described. Clearly in this case also it will be necessary to operate the relay 114 so as to switch the connection through without advancing the switch OCS through the position corresponding to the numerical digits.

It will be noted that there is an x inserted in each of the four leads connected with the switch SS, Fig. 2. These x 's indicate jack connections to the switch, the switch being arranged so that it can be removed from the jack contacts and another switch inserted. This is of particular importance for two reasons. In the first place, the switch SS may develop trouble and need to be replaced by a spare switch similarly wired. For this purpose it is intended that there shall be as many spare switches as there are switches in use so that in case any switch becomes defective it can be immediately replaced by a similar spare switch.

In case it becomes necessary to change the code required to elect trunking to a given office, a spare switch is wired up to conform with the new code used and is then inserted in the jack contacts in place of the switch SS.

As an alternative, the switches can always be provided in pairs, and there may be arranged two terminals corresponding to terminal 168 for each exchange. When this is done, one terminal is left unjumped, and the switch associated therewith is a spare switch and may be normally connected up in the same manner as its mate. If the switch in use becomes defective, the jumper 167 can simply be shifted over to the other terminal and the defective switch becomes the spare switch and may be repaired while the spare switch is in use. When this latter arrangement is used, the spare switch can be rewired in case a change in an exchange code is to be made and the exchange code is then changed by merely shifting the jumper from the switch in use to the spare switch.

What is claimed is:

1. In a multi-office telephone system employing register translators, impulse sending devices common to a plurality of said register translators, there being a separate one of said impulse sending devices for each office to which connections may be set up.

2. In a multi-office telephone system employing register translators and in which each office is designated by a distinctive code represented by a plurality of digits, a separate conductor for each office, registering apparatus in each register translator for selecting any one of said conductors, and means common to a plurality of said register translators for transmitting into a register translator over the said selected conductor the code digits assigned to the office to which the selected conductor corresponds.

3. In a telephone system, a plurality of register translators arranged to route calls to any one of a plurality of destinations, a routing code assigned to each such destination, certain of said codes comprising a plurality of digits each, there being a separate conductor assigned to each code, registering means included in each register translator for selecting any conductor, other registering means in each register translator, and means common to a plurality of register translators for transmitting, to the said other registering means in any register translator over the selected conductor, the code corresponding to such conductor.

4. In a telephone system, a plurality of register translators arranged to route calls to any one of a plurality of destinations, a routing code assigned to each such destination, certain of said codes comprising a plurality of digits each, there being a separate conductor assigned to each code, registering means included in each register translator for selecting any conductor, other registering means in any register translator, means common to a plurality of register

translators for transmitting to the said other registering means in any register translator over the selected conductor the code corresponding to such conductor, and sending means in any register translator operated under the control of said other registering means for retransmitting the code digits.

5. In a register translator for use in a multi-office telephone system in which each office is designated from a number standpoint by means of three digits and is designated from a trunking standpoint by means of a different digit combination, registering means in each register translator including a two-motion register having a plurality of wipers and a wiper-selecting single-motion register for registering the three digits in an office designation, code conductors equal in number to the offices in the system and corresponding respectively thereto, said conductors being accessible to said registering apparatus, and sending means in any register translator operated under the control of any selected one of said conductors to transmit the trunking digit combination of the office corresponding to the selected conductor.

6. In a telephone system, a register translating device for routing a received call in accordance with a code derived from the office designation in the called number, office registering apparatus for registering the office designations, said office registering apparatus having a wiper, means associated with said office register for transmitting characteristic impulses through said office register wiper to the register translator whereby a separate set of characteristic impulses is transmitted for each digit in the office code, a receiving device in said register translator responsive to said characteristic impulses, and means in the register translator controlled by said receiving device for retransmitting the code digits only after they are all received.

7. In a register translator system, registering apparatus in each register translator, each registering apparatus having a plurality of positions, sending devices equal in number to the number of said positions and corresponding respectively thereto, and means responsive to the setting of any registering apparatus into a given position for starting the common sending device corresponding to such position.

8. In a register translator system, a plurality of register translators, each register translator containing primary registering apparatus and secondary registering apparatus, each primary registering apparatus having a plurality of positions, a plurality of sending devices equal in number to the positions of the primary registering apparatus and corresponding respectively to such positions, and means responsive to the primary registering apparatus in any register trans-

lator being set into a given position and controlled from the sender corresponding to such positions for setting said secondary registering apparatus into a corresponding position.

9. In a register translator system, a plurality of register translators, each register translator containing primary registering apparatus and secondary registering apparatus, each primary registering apparatus having a plurality of positions, a plurality of sending devices equal in number to the positions of the primary registering apparatus and corresponding respectively to such positions, means responsive to the primary registering apparatus in any register translator being set into a given position and controlled from the sender corresponding to such positions for setting said secondary registering apparatus into a corresponding position, and sending means for retransmitting digit impulses corresponding to the set position of any secondary registering apparatus.

10. In a register-sender system containing a plurality of register senders, a step-by-step multi-position sending device common to all said register senders, a step-by-step multi-position receiving device in each of said register senders, means for associating the receiving device in any register sender with the sending device and for advancing the sending device and the associated receiving device in synchronism, registering apparatus connected to a plurality of positions of each receiving device, predetermined operating potentials connected to certain corresponding positions of said sending device, and circuit arrangements extending between the sending device and the connected receiving device such that said registering apparatus is operated in accordance with said predetermined connections.

11. In a register sender system wherein a multi-position step-by-step sending device is common to multi-position step-by-step receiving devices located in the several register senders, and in which registering apparatus in a register sender is operated in accordance with impulses transferred from a sending device to a receiving device while the two devices are being operated synchronously, a plurality of positions in which any receiving device may be brought to rest after the registering apparatus has been operated, said sending device being arranged to cause said receiving device to be brought to rest in a given one of said positions, other sending devices available for use in connection with any one of said receiving devices and each arranged to cause any connected receiving device to be brought to rest in a different position, and means in any register sender for performing any one of a plurality of specifically different operations depending upon in which of said positions a receiving device is brought to rest.

12. In combination, a distributing frame, control conductors, an office register operated in accordance with an office designation to select one of said conductors, an impulse sender, and means operated from said frame over the selected conductor for controlling said sender a plurality of times.

13. In combination, a distributing frame, control conductors, an office register operated in accordance with an office designation to select one of said conductors, an impulse sender, and means operated from said frame over the selected conductor for controlling said sender to send a plurality of digits.

14. In combination, a register having a wiper, means for setting said register, and storing means operated over said wiper in accordance with the set position of the register to store a plurality of digits.

15. In combination, a register having a wiper, a plurality of conductors accessible to said wiper and corresponding, respectively, to separate combinations of digits, and storing means operated over said wiper and any selected one of said conductors to store the corresponding combination of digits.

16. In combination, a register having a wiper, a plurality of conductors accessible to said wiper and corresponding, respectively, to separate combinations of digits, storing means operated over said wiper and any selected one of said conductors to store the corresponding combination of digits, and a sending device operable to transmit the stored digits.

17. In combination, a plurality of groups of storage relays arranged to store a like plurality of digits, respectively, a register having a wiper operable to select digit combinations to be stored, and means controlled over said wiper for operating said relay groups to store the selected digits.

18. In a call director, a digit register, another digit register having wipers, and means for operating the first named digit register to register a digit by selecting the corresponding one of said wipers.

19. In a call director, a digit register having wipers each corresponding to a different digit, and means responsive to impulses representing a digit for selecting the one of said wipers corresponding to such digit.

20. In a call director, two registers, the second of said registers having a plurality of wipers, means for operating the first register in accordance with a character to select a wiper of the second register, and means for operating the second register in accordance with a further character.

21. In a call director, two registers, one of said registers having a plurality of wipers, the other register being operable to select any one of said wipers, and means for operating said registers in accordance

with a portion of a telephone number.

22. In a call director, first and second registers, certain positions of the first register being associated with the second register, said second register having a plurality of set positions, means for operating said registers separately, and circuit connections such that circuit paths equal to the number of positions of the first register associated with the second register times the number of set positions of the second register may be prepared by the setting of the two registers.

23. In a call director, a two-motion register having a plurality of wipers, a single-motion register having a wiper having access to the wipers of the two motion register, and means for operating said registers to register the three initial characters of a telephone number.

24. In a call director, a single motion register having a wiper, a two motion register having a wiper, means for operating said registers to record three characters of a telephone number, a sender, and a control circuit for said sender including said two wipers in series.

25. In a director, two office registers arranged in tandem and operated successively responsive to the office designation in a number, a storage device, a circuit extending through the wipers of said registers in series for controlling said device, and a sender controlled by said device.

26. In a director, two office registers ar-

ranged in tandem and operated successively responsive to the office designation in a number, a circuit extending through wipers of said registers in series after the registers are set, a plurality of storage devices, means for successively setting said devices over said circuit, and a sender controlled by said devices successively.

27. In a director, a single motion register responsive to a digit in a number, a two motion register responsive to two other digits, a plurality of wipers on said second register, one of which is selected by the setting of the first register, a sender, and means controlled through the selected wiper for causing said sender to transmit a plurality of digits.

28. In a director, a plurality of code conductors, each corresponding to a different office, means for selecting a conductor by registering the office designation in a number, a sender, and means controlled over the selected conductor for causing the sender to transmit a plurality of code digits.

29. In a telephone system, directors, code senders common to said directors, each sender corresponding to a different office in the system, office registering means in each director for selecting a code sender, and a sender local to each director controlled by any selected code sender.

In witness whereof, I hereunto subscribe my name this 31st day of August, A. D. 1926.

JOHN E. OSTLINE.