Jan. 15, 1929. 1,699,457

F. TENCH

TELEPHONE SYSTEM

Original Filed Sept. 23, 1925 4 Sheets-Sheet 1

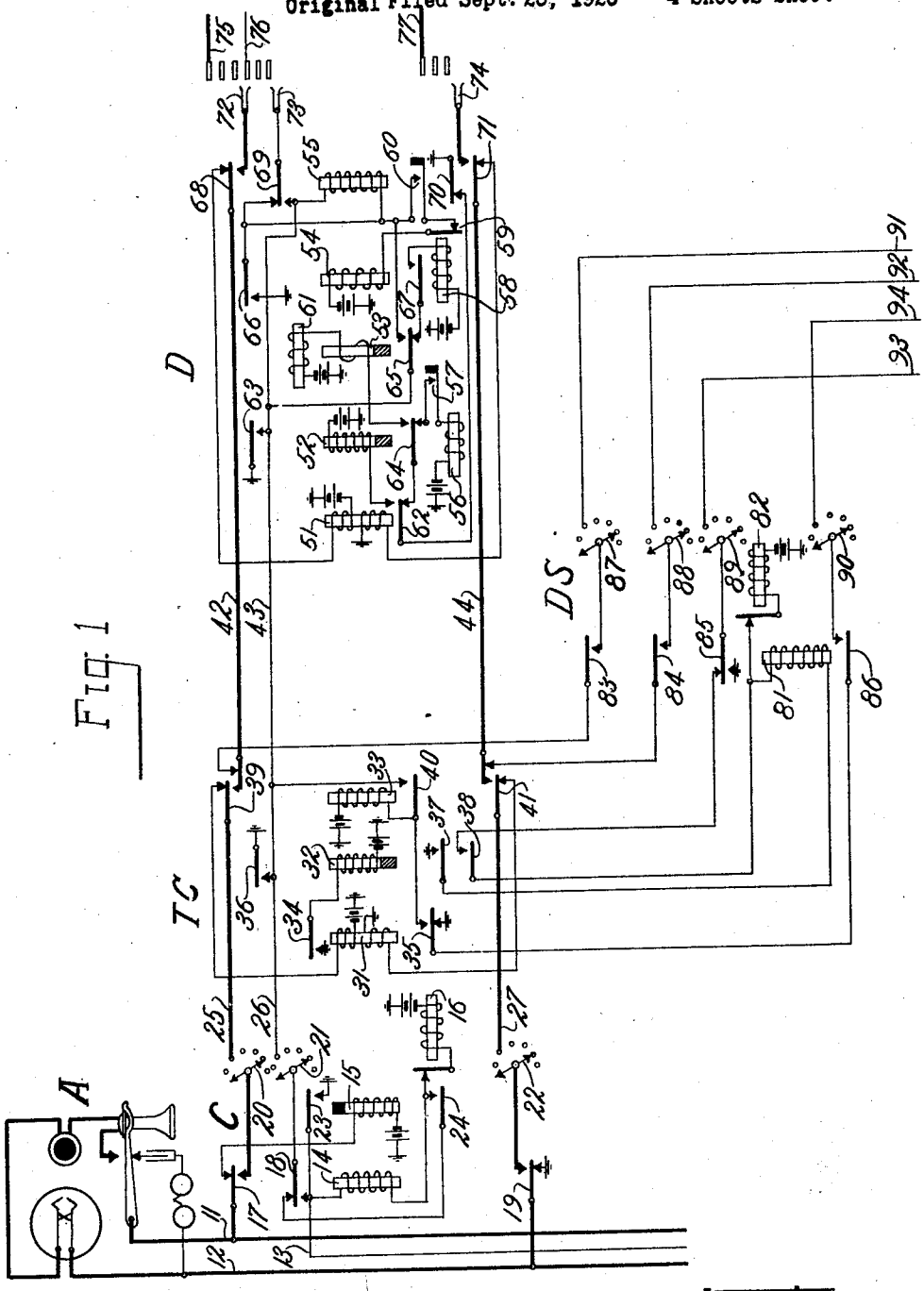


Fig. 1

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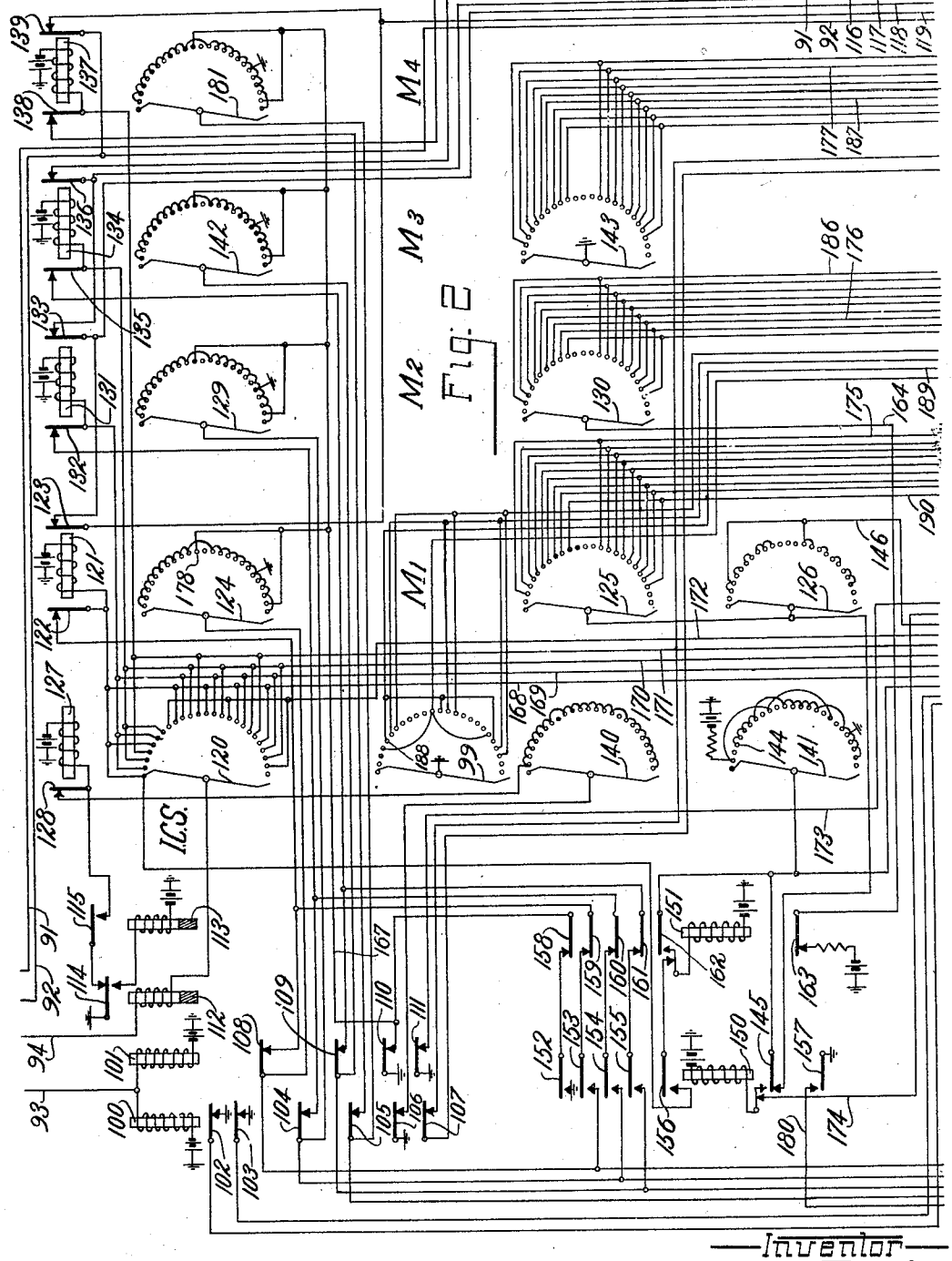


Fig. 2

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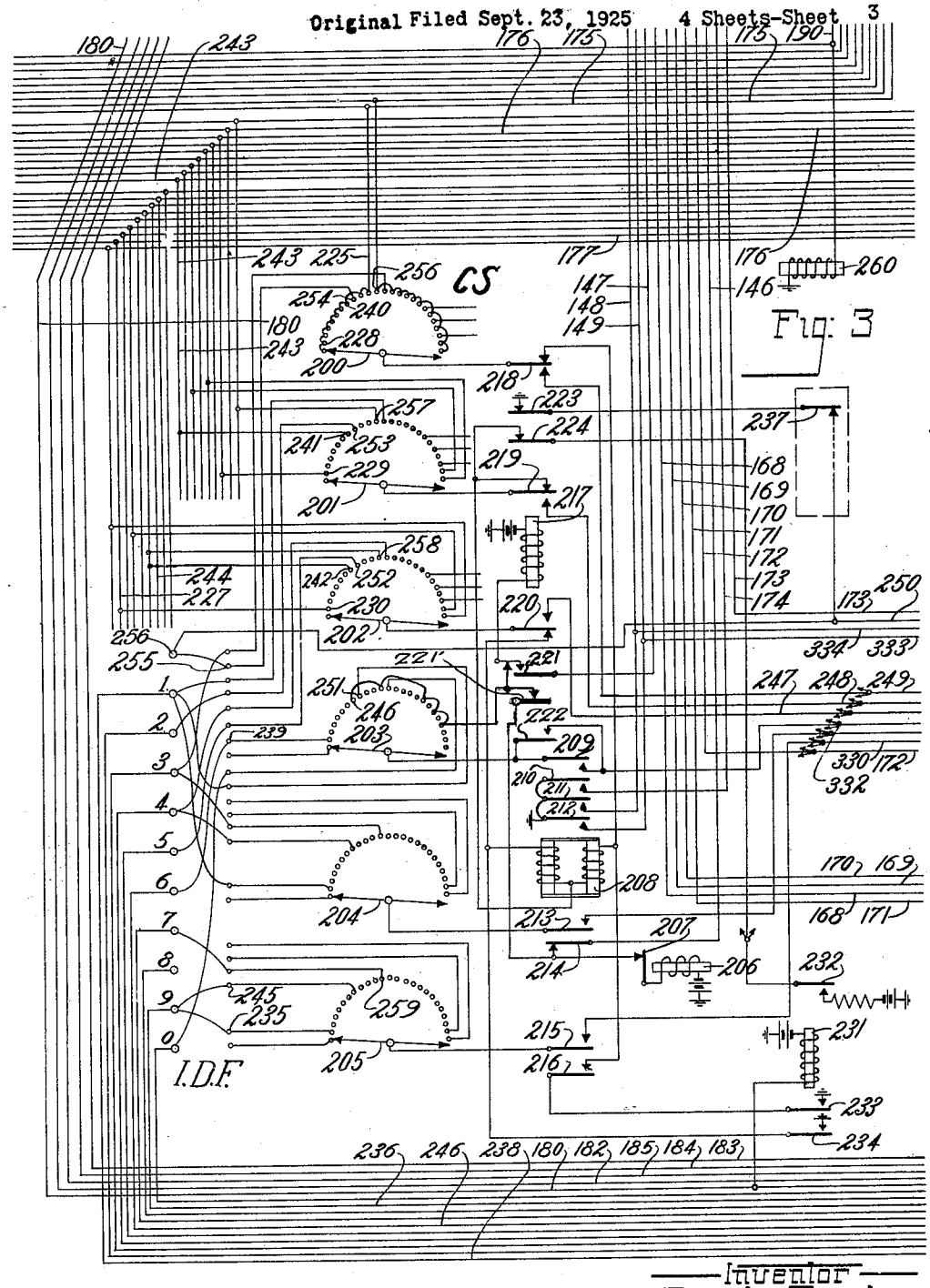


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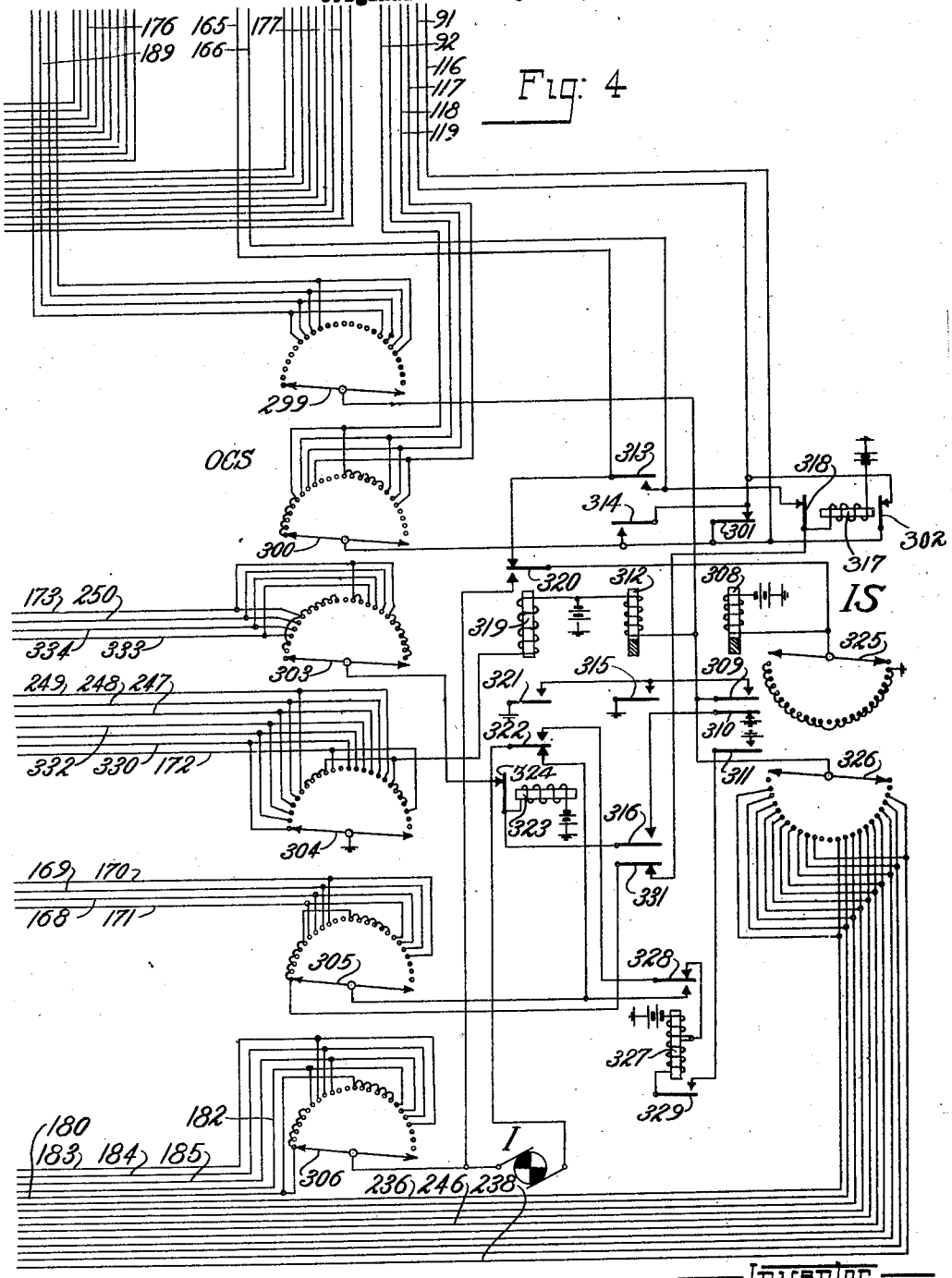
Fig. 4

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# UNITED STATES PATENT OFFICE.

FRANK TENCH, OF LONDON, ENGLAND, ASSIGNOR, BY MESNE ASSIGNMENTS, TO AUTOMATIC ELECTRIC INC., OF CHICAGO, ILLINOIS, A CORPORATION OF DELAWARE.

## TELEPHONE SYSTEM.

Application filed September 23, 1925, Serial No. 58,001, and in Great Britain January 6, 1925. Renewed April 26, 1928.

The present invention relates to telephone systems and is more particularly concerned with novel applications of automatic switches in circuit arrangements which permit more effective use to be made of the available contact points. The chief object of the invention may be stated briefly to be to enable the capacity of the switches to perform certain functions to be increased without increasing their size. The novel arrangements are particularly suitable for use in connection with register translators and such use will be considered in the description which is to follow. The improvement in the utility of the switches may be obtained by arranging for the switch to be used twice where previously it was only used once or by arranging for it to perform one operation by virtue of its setting and a further operation on its return to a normal position or also by arranging for the switch to make one or more auxiliary steps after its original setting.

According to one feature of the invention an automatic switch is provided in which the wipers are adapted to be connected up successively to control different operations and in which the switch is arranged to be advanced to a new position in between different operations so as to enable one wiper to be used twice for two different purposes.

According to another feature of the invention in an automatic switch adapted to hunt automatically under the control of one or more wipers, after the termination of a hunting movement the switch is adapted to take a predetermined number of additional steps whereupon the wipers previously used for controlling the hunting movement are brought into engagement with contacts over which an operation other than hunting is controlled.

Another feature of the invention relates to a register sender adapted to register wanted numbers and to send out trains of impulses in accordance therewith in which one or more of the register switches employed are adapted to be released in a plurality of stages between two of which impulses are adapted to be sent out.

A further feature of the invention is that in a register translator adapted to register wanted numbers and to send out trains of impulses in accordance therewith, a register switch is adapted to be used to record a plurality of digits in the called number, control in accordance with one of said digits being effected while the wiper of the switch is stationary in the position to which it has been set, while control in accordance with another digit is effected by the subsequent movement of the switch after it has been set to register this digit.

Still another feature of the invention is that in a register sender adapted to register wanted numbers and to send out trains of impulses in accordance therewith, the operating magnets of the register switches which record the designation of the wanted party control contacts in the circuit for sending out impulses, the contacts of each magnet being rendered ineffective until they are required to send out impulses.

These and other features of the invention not specifically mentioned at this point will be better understood from the following description of the principles of the invention as applied to a register translator system of the "director" type, on the lines of that described for instance in British Patent No. 194,580.

The present arrangement differs from that referred to in several distinct particulars, one of the most important of which is that all the switches now employed are of the same type and moreover are all grouped together to form a single unit which may be the same throughout the exchange. Preferably the switches are of the single-level type having 25 contacts in the bank and moving always in the same direction; such switches are already extensively employed for connecting a calling subscriber with a first numerical switch or the like. One advantage of having the switches of the register translator of an exclusively rotary type is that it allows a more compact assembly and reduces maintenance costs.

The advantage of using the register switches for effecting the generation of impulses is that it distributes the work more evenly and tends to give all the switches an equal life. Previously in systems of this character where a single impulse control switch controls the sending of all the trains of impulses, it has been found that this switch becomes worn out comparatively

soon, as it is rotating almost continuously. The use of the register switches for sending impulses involves in the arrangement about to be described a translation of the number dialled into its complement with respect to, in this case 11. This arrangement, however, need not present any serious difficulty as it is not a matter which affects the subscriber in any way and trunking may be carried out as if the more usual plan were adopted.

The system disclosed in this application is to some extent an improvement on or a modification of the systems disclosed in certain prior applications owned by the same assignee, and the claims herein are restricted to specific features which are not disclosed in such prior applications. The applications referred to are as follows: Richardson and Nelson, Serial No. 547,866, filed March 29, 1922; Nelson, Serial No. 573,175, filed July 6, 1922; Gillings, Serial No. 723,124, filed June 30, 1924; Passmore, Serial No. 752,138, filed November 25, 1924; and Richardson and Bellamy, Serial No. 694,842, filed February 25, 1924.

Referring now to the accompanying drawings comprising Figs. 1, 2, 3 and 4, these show one example of carrying the invention into practice, although it will be, of course, understood that various modifications might be made to the circuits without departing from the spirit of the invention.

Fig. 1 shows a subscriber's station A, the associated line switch C, and the trunk circuit TC with which is associated the first selector D and the register selector DS.

Figs. 2, 3 and 4 represent the register translator, the switches of which it will be noted are all single-level switches of the type which move in one direction only. In the example about to be described they are all 25 point switches of the type generally used for connecting the calling subscriber's line to a first numerical switch and are mechanically identical with the switch C.

The portion of the register translator shown in Fig. 2 comprises the in-put control switch ICS which has four banks and the digit registers $M^1$, $M^2$, $M^3$ and $M^4$, of which $M^1$ has three banks, $M^2$ and $M^3$ have two banks each, and $M^4$ has one bank. The reasons for the difference in the numbers of banks of these various register switches will appear in due course.

Fig. 3 shows one of the code switches CS of which four are assumed to be provided in the present system which comprises a network having about 70 or 80 exchanges. Only one of these code switches is shown, however, in order to prevent the drawing becoming unduly complicated, since the circuits of the others are precisely similar and the method of their operation will be at once apparent to those skilled in the art.

Fig. 4 shows the output control switch OCS and the impulse control switch IS. This latter it will be seen from the following description is only used for controlling the sending of the impulses corresponding to the exchange code, the control of the impulses comprising the numerical digits being effected by the digit registers $M^4$, $M^1$, $M^2$ and $M^3$ on returning to their normal position.

In order that the operation of the apparatus may be traced through in detail, assume that the subscriber at A wishes to call the subscriber whose number is Avenue 3456 and that the calling subscriber A accordingly dials the number 283—3456, 283 being the numerical equivalent of the first three letters AVE of the exchange name which is converted by the register translator into the digits 916. When the subscriber at A removes his receiver, a circuit is completed over the line conductors 11 and 12 and armatures 17 and 19 and their back contacts for line relay 15. Relay 15, upon energizing, at armature 23 completes a circuit for switching relay 14 and rotary magnet 16 in series and at armature 24 connects test wiper 21 to the junction of switches relay 14 and rotary magnet 16. At armature 23 moreover earth is connected to private normal conductor 13 in order to make the line of substation A busy in the banks of the connectors having access thereto. The line switch C now commences to hunt in known manner and it will be assumed that the first idle trunk encountered is that shown on the drawings comprising the trunk circuit TC and the associated selector D and register selector DS. Since the wiper 21 does not now find earth, relay 14 is no longer short circuited and energizes in series with magnet 16 which is not now energized, however, owing to the high resistance of relay 14. Relay 14 at armature 18 completes a locking circuit for itself and at armature 17 and 19 connects the speaking conductors through, whereupon a circuit is completed for line relay 31 of the trunk circuit over the subscriber's loop and armatures 39 and 41 and their back contacts. Relay 31, upon energizing, at armature 35 prepares a circuit for relay 33 and at armature 34 completes a circuit for slow relay 32. Relay 32, upon energizing, at armature 36 connects earth to release trunk conductor 26 before it has been removed at armature 23 so as to maintain relay 14 operated, at armature 37 completes a circuit for switching relay 81 and magnet 82 of the register selector DS in series and at armature 38 connects test wiper 89 to the junction of relay 81 and magnet 82. The switch DS now commences to hunt for a free register translator in the same manner as did the switch C, and it will be assumed that the first one found idle is that shown in Figs. 2, 3 and 4 to

which access is had over conductors 91, 92, 93, 94. When the wipers of DS reach the position shown, since the register translator is assumed to be idle, relay 81 is no longer short circuited and energizes, thereupon at armatures 83 and 94 preparing the outgoing impulsing circuit, at armature 86 closing another point in the circuit of relay 33 and at armature 85 disconnecting test wiper 89 from the above mentioned circuit, and connecting to it direct earth. Upon the operation of armatures 83 and 84 a circuit is completed for line relay 51 of the selector D which extends as follows: earth, lower winding of relay 51, back contact and armature 71, conductor 44, normally closed springs controlled by armature 41, armature 84 and its front contact, wiper 88, conductor 92, multiplied contacts 1 to 6 in the bank of wiper 300 of the switch OCS, armatures 301 and 302 and their back contacts in parallel, lead 91, wiper 87, front contact and armature 83, normally closed springs controlled by armature 39, conductor 42, armature 68 and its back contact, upper winding of relay 51 to battery. Relay 51 operates in this circuit and at its armature 62 completes a circuit for slow release relay 52 which also energizes so that the switch is prepared for operation in the usual manner. The connection of earth to conductor 93 has the effect of energizing relays 100 and 101, whereupon restoring circuits for the various switches are opened so that it may be possible for these switches to remain in an off normal position.

The register translator is now in condition to receive the impulses transmitted by the calling subscriber and with the assumption made above the first series comprises two impulses. When this is dialled, line relay 31 of the trunk circuit TC is momentarily deenergized twice and each time a circuit is completed as follows: earth, back contact and armature 35, armature 86 and its front contact, wiper 90, conductor 94, winding of relay 112, wiper 120 of the input control switch ICS and its front contact, winding of magnet 121 to battery. Relay 112 and magnet 121 energize in series in this circuit and the former at armature 114 completes a circuit for relay 113. At the end of each impulse, magnet 121 deenergizes and advances the wipers 124, 125, and 126 of the first digit register $M^1$ one step so that they are moved into engagement with the second contact in their respective banks. Relay 112 is made slow to release in order that it shall hold up throughout the train of impulses and on their termination releases after a short interval and at armature 114 completed a circuit over armature 115 and its front contact for the magnet 127 of the switch ICS. This circuit remains closed until relay 113 of the switch ICS deenergizes after a short interval, and on the release of magnet 127, wipers 120, 99, 140 and 141 are moved on one step so as to direct the impulses representing the second digit to the register $M^2$.

The subscriber will now dial the next digit in the wanted number which is assumed to be 8, and accordingly eight impulses are transmitted over lead 94 by the operation of armature 35 and are extended over wiper 120 and the second contact in its bank to magnet 131 of the second digit register $M^2$. This, therefore, advances its wipers 129 and 130 into engagement with the ninth contact in their respective banks. Relay 112 is energized as before and effects the energization of relay 113, these two relays then serving to advance the wipers of the switch ICS a further step on the termination of this series of impulses.

The succeeding digit, in this case 3, is transmitted in a similar manner, but since wiper 120 is now in engagement with the third contact in its bank, the impulses are transmitted to the magnet 134 of the third digit register $M^3$, and this accordingly advances its wipers 142 and 143 into engagement with the fourth contacts in their respective banks. The input control switch ICS is moved on a further step at the end of this series of impulses in a manner similar to that previously described and is then in a position to route the first numerical digit to the digit register $M^4$.

The three digits corresponding to the exchange name have now been registered and hence it is determined to which exchange the call is to be routed. It is, therefore, now possible for the sending of the train of impulses necessary for extending the connection to this exchange to commence, this operation being controlled by the code switch CS. It has been previously mentioned that with a system of the size assumed there are four of these code switches, only one of which CS, Fig. 3, is shown. In order that it shall not be necessary for all four switches to commence a hunting operation for every connection when only one of such operations can possibly be effective, each switch is assigned to particular first digits; for instance, it is assumed that the code switch shown is only started up when the first digit of the exchange name is 2 or 3, the second in response to a first digit which is 4 or 5, the third in response to 6 or 7, and the fourth in response to 8 or 9. It may be mentioned in passing that one is not used as the first digit of an exchange name owing to the possibility of confusion with a false impulse, while O is used for obtaining access to an operator as will subsequently be described. The discrimination necessary for starting up the right switch is effected over the wiper 126 of the first digit register $M^1$ in a man-

ner which will now be described. As soon as the wiper 141 of the switch ICS engages the fourth contact 144 in its bank, a circuit is completed as follows: earth, contact 144, wiper 141, armature 145 and its back contact, wiper 126, lead 146, armature 214 and its back contact, interrupter contact 207, winding of magnet 206 to battery. The code switch CS is therefore started hunting and this operation continues until the above circuit is broken at armature 214 upon the operation of shunt field relay 208. When the switch ICS advanced to its fourth position a circuit was also completed from earth, contact 144, wiper 141, armature 145 and its back contact to wiper 125, which it will be remembered is standing on its third contact. Earth is thus connected to lead 175 and battery is connected over back contact and armature 163, lead 164, wiper 130 and the ninth contact of its bank to lead 176, and also earth is connected from wiper 143 over the fourth contact in its bank to lead 177. As may be seen from Fig. 2 these leads are connected by way of leads 225, 226 and 227 to contacts 228, 229 and 230, respectively, in the banks of wipers 200, 201 and 202. Consequently, if it is assumed that these wipers were originally standing in the position shown in Figure 2, it will only be necessary for them to make one step before they encounter the contacts which have been marked owing to the operation of the digit registers $M^1$, $M^2$ and $M^3$. Hence when the switch has taken this step, shunt field relay 208 is energized and at armature 214 opens the circuit for magnet 206 and at armatures 209, 213 and 215 connects up the wipers 203, 204, and 205 of the switch CS. Relay 208, moreover, at armature 216 prepares a locking circuit for itself, at armatures 211 and 212 prepares circuits which will be described subsequently, and at armature 210 connects earth to lead 174 thereby completing a circuit for relay 150. Relay 150, upon operating, at armature 145 opens its initial energizing circuit and locks itself up to lead 147, at the same time disconnecting earth from wipers 125 and 126 so as to prevent the possibility of any other code switches being started up subsequently, or any other shunt field relay operating. At armatures 153, 154, 155, circuits are completed for restoring the digit registers $M^1$, $M^2$, $M^3$ to normal, the circuit in the case of the register $M^1$ extending as follows: earth from the multiple contacts in the bank of wiper 124 and said wiper, front contact and armature 153, back contact and armature 159, interrupter contact 122, winding of magnet 121 to battery. The wipers 124, 125 and 126 are thus rotated forwards until wiper 124 engages contact 179 which is not earthed so that the above circuit is broken. It will be noted that at this time earth is connected to contact 178 by way of armature 152, back contact and armature 158 and lead 167 so that wiper 124 does not stop on this contact. The circuits for the registers $M^2$ and $M^3$ are similar and need not be traced in detail. Relay 150 moreover at armature 156 prepares a circuit for relay 151 and at armature 157 connects earth to lead 180. This earth has the effect of energizing relay 231 which thereupon by operating its armatures 232, 233 and 234 completes locking circuits for the shunt field relay 208, so that this will not deenergize when its original circuit is opened by the return of the wipers 125, 130 and 143 to normal. The earth on lead 180 also extends to the first contact in the bank of wiper 306 of the output control switch OCS, and over the wiper by way of the interrupter I and armature 322 and its back contact, wiper 305, first contact in its bank, armature 331 and its back contact, winding of magnet 317 of the impulse control switch IS to battery. The interrupter I is preferably power driven at such a speed as to produce interruptions at the rate of approximately 10 per second. At this time an earth connection is extended by way of wiper 304 and its first contact, lead 330, front contact and armature 215, wiper 205, and the second contact in its bank, terminal 235 on the right hand side of the intermediate distributing frame, hereafter referred to as the I. D. F., jumper to terminal 9 on the left hand side of the I. D. F., lead 236, to the eleventh contact in the bank of wiper 326. When the interrupter I next closes its contacts, magnet 317 is energized and when subsequently the circuit is opened by the interrupter I, magnet 317 deenergizes and advances the wipers 325 and 326 one step, whereupon a circuit is completed from the multiple earthed contacts in the bank of wiper 325 for relay 308. Relay 308 upon energizing, at its armature 301 removes one of the multiple connections across the impulsing leads 91 and 92, at armature 309 prepares a circuit for relay 312, at armature 310 opens a point in the circuit of magnet 323 of the output control switch OCS and at armature 311 prepares a locking circuit for the two-step relay 327, which will not be required, however, at this stage. Owing to the continued operation of the interrupter, magnet 317 is again energized in due course and at its armature 302 opens a point in the circuit of line relay 51 of the selector D, which circuit it will be remembered extends from lead 92 over wiper 300 of the switch OCS and through armature 302 and its back contact to lead 91; consequently one impulse is transmitted to the selector D and it operates to raise its wipers one step in the well known manner. In response to the further operation of the interrupter I, the wipers 325 and 326 are advanced step-by-step and

upon each step the loop to the selector D is opened at armature 302. This continues until wiper 326 engages the eleventh contact in its bank to which earth is connected over the circuit previously traced. When wiper 326 reaches this contact a circuit is completed for the stop relay 312, which upon energizing, at armature 313 completes a restoring circuit for magnet 317 by way of interrupter contact 318, whereupon wipers 325 and 326 are advanced until wiper 325 reaches a contact which is not earthed. Relay 312 moreover at armature 314 places a shunt around armature 302 so that subsequent operations of this armature while the switch IS is returning to normal shall not send impulses to the selector D, at armature 315 completes a locking circuit for itself, at armature 316 prepares a circuit for magnet 323, and at armature 331 opens the circuit from interrupter I to the magnet 317. It will be appreciated that when relay 312 is thus operated, 9 interruptions will have been sent over the loop circuit, and consequently the selector D will have been raised to the ninth level. The hunting operation of this selector will then be initiated and a succeeding switch will be taken into use and prepared for operation in the usual manner; this hunting operation takes place while the switch IS is restoring to normal. As soon as wiper 325 fails to find earth, the circuit is no longer completed for relay 308 and it therefore deenergizes after a short interval owing to its slow to release characteristic. The deenergization of relay 308 completes the circuit for magnet 323 and opens the locking circuit of relay 312. Relay 312, therefore, deenergizes after a short interval and at armature 316 opens the circuit of magnet 323, whereupon the wipers 299, 200, 303, 304, 305, 306 of the switch OCS are advanced one step and at armature 331 again completes the circuit for magnet 317 so that the sending of the next digit may commence. This next digit in the present case is one which is determined by the fact that the connection from the second contact in the bank of wiper 304 is made to terminal 1 on the left hand side of the I. D. F. Consequently the next train of impulses sent out for reaching the desired Avenue exchange consists of one impulse only and as soon as wiper 326 reaches its third contact, to which lead 238 is connected, the sending of impulses is stopped and the switch IS is returned automatically to its normal position in the manner previously described.

Upon the subsequent release of relay 312, magnet 323 is deenergized and the switch OCS is advanced a further step. Earth is now connected over wiper 304 and its third contact, lead 332, front contact and armature 209, wiper 203 and the second contact in its bank, terminal 239, jumper to terminal 6 on the left hand side of the I. D. F., lead 246', to the eighth contact in the bank of wiper 326. As soon as armature 331 again engages its back contact, impulses are again transmitted to magnet 317 and a train of impulses comprising in this case six impulses, is sent over conductors 91 and 92 for operating the switches for extending the peaking connection. It will be noticed that the loop circuit which is interrupted to operate these switches remains for the present the same as that previously traced owing to the fact that the first six contacts in the bank of wiper 300 are multiplied together. It is assumed that to obtain access to the Avenue exchange in which the called party's line terminates requires only three trains of impulses so that the wipers 203, 204, and 205 of the code switch are sufficient to deal with the situation and consequently it is not necessary for the switch CS to take an additional step to bring into use the wipers 200, 201, 202 for impulse controlling purposes. Thus all the impulses required to select the wanted exchange have now been sent and transmission of the numerical digits may take place immediately.

To return for a moment to the consideration of the operations which take place at the registers $M^1$, $M^2$, $M^3$ and $M^4$ during the registration of the numerical digits, it has already been explained that the first numerical digit is registered on the switch $M^4$ in a similar manner to the operation of the registers already described. The description was previously taken to the point at which relay 150 had been energized and the switch $M^1$, $M^2$ and $M^3$ thus had circuits completed for restoring them to their normal positions. It may be considered that the time required for the subscriber to dial the first numerical digit together with the pauses before and after such digit will be ample for the code switch concerned to complete its operation and for the registers $M^1$, $M^2$ and $M^3$ to be restored to normal. Hence by the time the first impulse of the second numerical digit is received, register $M^1$, $M^2$ and $M^3$ will be back at normal. In the present case this digit is 4 and four earth impulses will therefore be sent over lead 94. The circuit now extends through relay 112 to wiper 120 and over its fifth contact to magnet 121 so that the digit 4 is set up on the register $M^1$. At the same time a circuit is completed over wiper 120 and front contact and armature 156, normally closed springs controlled by armature 162 for relay 151. This, therefore, operates; at armature 158 removes earth from lead 167 so that when restoring circuits are subsequently completed for the switches $M^1$, $M^2$, $M^3$ and $M^4$ the wipers will be arrested when they encounter contacts connected to this lead; at armatures 159, 160 and 161 opens the restoring circuits previously closed so as to permit the wipers to

take up an off normal position; at armature 162 completes a locking circuit for itself and at armature 163 removes battery from wiper 130 so as to prevent the possibility of the shunt field relay associated with any other code switch energizing in case the wipers of that switch should be resting on contacts connected to the contacts on which the wipers 125, 130 and 143 of $M^1$, $M^2$ and $M^3$ are subsequently set. The third and fourth numerical digits are then sent in the same way and are recorded on the registers $M^2$ and $M^3$ in the manner which will be clearly understood from what has already been said. At the end of the seventh and last series of impulses, the input control switch ICS is moved on in the usual manner so that wiper 120 is connected to lead 172 in order to prepare a switching circuit which will be described in due course.

Considering now the further operation of the output control switch OCS after the third exchange selecting digit has been sent, wipers 299, 300, 303, 304, 305 and 306 are advanced into fourth position in the usual manner whereupon a circuit may be traced as follows: earth, armature 212 and its front contact, lead 333, fourth contact in the bank of wiper 303 and said wiper, interrupter contact 324, magnet 323 to battery. The wipers of the switch OCS are thus advanced a further step whereupon a similar circuit is completed, in this instance over armature 211 and its front contact, lead 334, and the fifth contact in the bank of wiper 303 so that the wipers are advanced to sixth position. In this position a circuit is completed from earth by way of back contact and armature 223, chain of similar contacts indicated at 237 on the relays such as 217 associated with the other code switches to the sixth contact in the bank of wiper 303 so that the switch OCS is advanced to seventh position. A circuit is now completed as follows: earth, wiper 304, seventh contact in its bank, winding of relay 319 to battery. Relay 319 thereupon operates; at armature 320 prepares an alternative circuit for relay 308, at armature 321 prepares a circuit for relay 312 and at armature 322 prepares a circuit for the two-step relay 327. Moreover, owing to the fact that wiper 300 has now arrived at its seventh contact, interrupter contact 139 is now included in the outgoing impulsing circuit over leads 91 and 92. Since wiper 181 of the switch $M^4$ is now resting on its fourth contact a circuit is completed as follows: earth, fourth contact in the bank of wiper 181 and said wiper, conductor 182, seventh contact in the bank of wiper 306 and said wiper, front contact and armature 320, winding of relay 308 to battery. Relay 308, therefore, operates and at armature 301 opens the shunt around armature 302 which is, however, without effect in this case since armature 302 will not now be operated; at armature 309 completes the circuit for relay 312; at armature 310 opens a point in the circuit of magnet 323 and at armature 311 prepares a locking circuit for relay 327. Relay 312 now energizes and operates armatures 313, 314, 315, and 331 as before but in this case without effect, and at armature 316 prepares a circuit for magnet 323. A branch of the above traced circuit from wiper 181 of switch $M^4$ extends by way of the interrupter I, armature 322 and its front contact, armature 328 and its back contact, upper winding of relay 327 to battery. Consequently when interrupter I next closes its contacts, relay 327 will be partially energized and will operate its light armature 329, thereby connecting earth to the other terminal of its lower winding so that for the present this winding is short circuited. When the interrupter contacts open again, relay 327 energizes fully over both windings in series and operates its armature 328, whereupon the circuit from the interrupter is extended to wiper 305 and over the seventh contact in its bank, lead 171, winding of magnet 137 to battery. Hence, it will appreciated that as the interrupter continues to rotate, impulses will be sent to magnet 137 so as to operate wiper 181 and this will continue until the wiper reaches its twelfth contact which is connected to lead 167; since this lead is not earthed at this time there is no further operating earth for magnet 137 and the switch comes to rest. Moreover, owing to this removal of earth, relay 308 is deenergized and releases, thereby at armature 309 opening the circuit of relay 312, at armature 310 completing a circuit for magnet 323 and at armature 311 opening the locking circuit for relay 327 which therefore deenergizes. Relay 312 also deenergizes after the interval for which it is adjusted and by releasing armature 316 effects the deenergization of magnet 323 so that the wipers of the switch OCS are advanced a further step.

It will be seen that on each operation of the magnet 137 of the register $M^4$ the outgoing loop including conductor 119 was interrupted at the contact 139 so that since the switch wiper 181 was originally on the fourth contact and was advanced to the twelfth contact, eight impulses were sent. As will be appreciated more clearly from the subsequent description, the numerical digits are not sent out exactly as received from the calling subscriber but instead a number of impulses is sent representing the difference between the number of impulses dialled and eleven so that the value of the train of impulses sent out may be considered as complementary to the value of the series dialled.

When magnet 323 deenergizes the switch

OCS is advanced to its eighth position and a circuit may then be traced as follows: earth, fifth contact in the bank of wiper 124 and said wiper, lead 183, eighth contact in the bank of wiper 306 and said wiper, front contact and armature 320, winding of relay 308 to battery and in parallel thereto over interrupter I, armature 322 and its front contact, armature 328 and its back contact and upper winding of relay 327 to battery. Relay 308 now operates with the previously described results while two-step relay 327 also operates partially as before and when fully energized transfers the above earth by way of armature 328 and its front contact to wiper 305 and the eighth contact in its bank, lead 168, winding of magnet 121 to battery. It will be realized that the function of the relay 327 is to guard against an imperfect first impulse being sent in case the switch OCS should be moved on while the contacts of the interrupter I are closed. The sending of the series of impulses corresponding to the second numerical digit now continues in a manner similar to that previously described, the loop circuit in this case extending from conductor 91, back contact and armature 302, and armature 314 and its front contact in parallel, wiper 300 and the eighth contact in its bank, lead 118, back contact and armature 123, back contact and armature 139 to lead 92. In this case it is impossible for magnet 137 to be again energized at this time so that the control is entirely by armature 123. Hence seven impulses are sent over the outgoing trunk line while wiper 124 is advancing until it reaches the dead contact, which is connected to lead 167.

The sending of the remaining series of impulses which will comprise 6 and 5 impulses, respectively, now proceeds under the control of registers $M^2$ and $M^3$ in a manner which will be readily followed. In the former case, earth is obtained over lead 184 and after the operation of relay 327 is extended to magnet 131 over lead 169, while interrupter contact 133 is included in the impulsing circuit by way of lead 117. For the last digit earth extends from the bank of wiper 142 over lead 185 and is fed to magnet 134 over lead 170 and owing to the advance of wiper 300 contact 136 generates impulses in a circuit including lead 116. On the termination of the transmission of the last series of impulses, the output control switch is moved on in the usual manner into its eleventh position and a circuit may then be traced as follows: earth, wiper 304 and its eleventh contact, lead 172, eighth contact in the bank of wiper 120 and said wiper, relay 112, lead 94, wiper 90, front contact and armature 86, armature 35 and its front contact, winding of relay 33 to battery. Relay 33 thereupon operates; at armature 40 completes a locking circuit for itself to release trunk conductor 43 and at armatures 39 and 41 connects the speaking leads through, at the same time disconnecting the outgoing pulsing leads and also opening the circuit of the line relay 31. Line relay 31, thereupon deenergizes and at armature 34 opens the circuit of release relay 32 which deenergizes also after a short interval. Thereupon the circuit which is maintaining relay 81 energized is opened and this relay releases, thus freeing the register translator by the removal of earth from lead 93.

When this occurs, relays 100 and 101 deenergize and the latter at armature 110 connects earth to lead 167 whereupon circuits are completed for advancing the digit registers $M^1$, $M^2$, $M^3$ and $M^4$ to their normal positions.

These circuits will be seen to extend over armatures 108, 104, 109, 105 and their back contacts, and interrupter contacts 122, 132, 135 and 138 to magnets 121, 131, 134 and 137, respectively. Moreover, at armatures 102 and 103 and over leads 148 and 149 and also over armature 111 and lead 173 circuits are completed for restoring the switch OCS to normal. Armature 107 completes a circuit for restoring the switch IS to normal, this circuit, however, being ineffective in the present instance since this switch is already at normal. At armature 106 a circuit is completed which extends to magnet 127 by way of wiper 140 and interrupter contact 128 and serves to restore the switch ICS to normal. These circuits are more particularly provided to deal with the case in which the register translator is not completely operated, owing, for instance, to the subscriber hanging up his receiver after having dialled only a portion of the number. The code switch CS and the similar code switches which are not shown are adapted to remain on the contacts last used and hence they make no movement when the register translator is released. The locking circuits for relays 150 and 151 are opened when wiper 141 reaches its normal position and the release of relay 150 opens the circuit for relay 231. This accordingly releases and opens the locking circuit for the shunt field relay 208. The circuit for relay 319 was opened as soon as wiper 304 moved into its eleventh position so that this relay is deenergized before the switching through operation takes place. Thus all the apparatus employed has been restored to normal and the register translator may be used for setting up other connections.

The case will now be considered in which the subscriber A wishes to call a subscriber whose number is Barking 3456 in consequence of which he will dial BAR 3456, and it will be assumed that with the lettering of the dial employed BAR corresponds to 227.

It will further be assumed that Barking is located at some distance from the originating exchange, and that in consequence it is necessary to send five trains of impulses in order to select the Barking exchange, the code digits being 94152.

In order to initiate the call the subscriber will remove his receiver in the usual manner, and it will be assumed that his line switch C thereupon again seizes the trunk circuit shown in Fig. 1 and that the register selector DS then commences to operate, and again seizes the register translator shown in Figs. 2, 3 and 4. In response to the dialling of the first digit 2, two impulses will be sent by way of slow relay 112 and over wiper 120 to magnet 121 of the first digit register $M^1$ which will, therefore, be advanced two steps as in the case previously considered. The input control switch ICS will then advance one step so that the next digit which is also 2 will be routed to the magnet 131 of the second digit register $M^2$, which in its turn will be advanced two steps. In a similar manner the third digit which is 7 will be transmitted to the magnet 134 of the third digit register $M^3$ which will accordingly be advanced seven steps. On the completion of this series of impulses the switch ICS will be advanced a further step and a circuit will then be completed over wiper 141 for starting the hunting of the code switch CS which will again be used since the first exchange digit is 2. The contacts which are now marked in the banks of the switch CS are contacts 240, 241 and 242, the circuits to which may be traced as follows: earth is connected from wiper 141 at contact 144, armature 145 and its back contact, wiper 125, third contact in its bank, lead 175, lead 225 to contact 240. Battery is connected by way of back contact and armature 163, lead 154, wiper 130 and the third contact in its bank, lead 186, lead 243 to contact 241. Earth is also extended over wiper 143 and the eighth contact in its bank, lead 187, lead 244 to contact 242. The switch CS therefore hunts to find these contacts in the manner previously described, and when they are reached, the shunt field relay 208 is energized over the circuits traced and operates as before to open the hunting circuit, to prepare a locking circuit for itself, to connect up the wipers 203, 204, 205 of the code switch and to energize relay 150. The energization of relay 150 completes a circuit for relay 231 which completes locking circuits for relay 208 and a circuit is also completed for restoring the switches $M^1$, $M^2$ and $M^3$ to normal in readiness for receiving the second, third and fourth numerical digits. In the meantime the first numerical digit 3 is being stored on the register $M^4$ and the transmission of the exchange selecting impulses will have commenced. As in the case previously described, as soon as the impulses representing the second numerical digit are received, a circuit is completed for relay 151 which operates to open the restoring circuits for the registers $M^1$, $M^2$, $M^3$ so as to allow these registers to remain in an off normal position.

Consider now the transmission of the impulses necessary for selecting the Barking exchange. When earth is connected to lead 180, it is extended as before over the multipled contacts in the bank of wiper 306 and the said wiper, interrupter I, armature 322 and it back contact to wiper 305, multipled contacts in its bank, armature 331 and its back contact, magnet 317 to battery. In this case the earth stopping the operation of the sending switch when the required number of impulses have been sent out extends from wiper 304 over lead 330, front contact and armature 215, wiper 205, terminal 245, jumper to terminal 9 on the left hand side of the I. D. F. and thence to the contact in the bank of wiper 326 which corresponds to the transmission of nine impulses. When this contact is reached, the stop relay 312 is energized over wiper 326 and the circuit just traced and operates to shunt the interrupter armature 302, to effect the return of the switch IS to normal, to complete a locking circuit for itself, to prepare a circuit for magnet 323 and to cut off the interrupter I. When the switch IS reaches normal position the circuit of relay 308 is opened and it deenergizes thereby opening the circuit of relay 312 which deenergizes also. After the lapse of the interval represented by the release time of these two slow relays, the circuit of magnet 317 is again intermittently closed. Wiper 304 is now in engagement with its second contact, and consequently earth is extended by way of front contact and armature 213 to wiper 204 and thence by way of terminal 4 on the left hand side of the I. D. F. to the corresponding contact in the bank of wiper 326; thus four impulses are sent for the second exchange selecting digit. When the wipers of the switch OCS are now moved on a further step, the following circuit is completed: earth 304, third contact in its bank, lead 332, front contact and armature 209, wiper 203, contact 246, normally closed springs controlled by armature 221, winding of relay 217 to battery. Relay 217 operates and at armature 221′, extends a branch of this circuit through the interrupter contact 207 and winding of magnet 206 to battery. Magnet 206 therefore energizes and operates its interrupter contact, thereupon opening its circuit, so that it then deenergizes and advances the wipers 200–205, inclusive, one step. Since the circuit over contact 246 is now broken, it is not possible for any further operation of magnet 206 to take place.

At armature 221 relay 217 completes a locking circuit for itself to earth on wiper 141 by way of lead 147, and at armatures 218, 219 and 220 disconnects wipers 220, 201 and 202, respectively, from the winding of the shunt field relay and connects them to leads 249, 248 and 247 which extend to the sixth, fifth and fourth contact in the bank of wiper 304, respectively. Relay 217 also at armature 222 and its front contact shunts armature 209, at armature 223 removes earth from lead 250 for a purpose which will appear subsequently, and at armature 224 opens the locking circuit for the shunt field relay 208. Relay 208 therefore deenergizes and at armatures 211 and 212 removes earth from leads 334 and 333 and at armature 214 again closes a point in the hunting circuit for magnet 206. It is not now possible, however, for this circuit to be closed owing to the fact that even supposing wiper 126 should come to rest on either its third or fourth contact, which may not be the case, earth is disconnected from wiper 125 at armature 145. Owing to the advance of the wipers of the code switch one step, the earth which served to operate relay 217 is now extended over contact 251 to terminal 1 on the left hand side of the I. D. F., which determines that the next train of impulses sent out shall comprise one impulse only. Three trains of impulses have now been sent out as in the connection previously described, but in this case as there are still two more to be sent, the output control switch must not run through its fourth, fifth and sixth positions, as it will be necessary for it to control the transmission of impulses in its fourth and fifth positions. The switch OCS is prevented from advancing too rapidly in this case owing to the fact that earth has been removed from lead 333 at armature 212 owing to the deenergization of relay 208. In the fourth position of switch OCS, earth is extended from wiper 304 and the fourth contact in its bank over lead 247, front contact and armature 220, wiper 202, contact 252, terminal 5 on the left hand side of the I. D. F. to the corresponding contact in the bank of wiper 326, so that it is thus determined that the next train of impulses shall comprise 5. After this train has been completed, the wipers of the output control switch OCS are moved on in the usual manner and earth is then extended over lead 248 and front contact and armature 219 to wiper 201 and thence over contact 253 to terminal 2 on the left hand side of the I. D. F. so that the next impulse train comprises two impulses. When this is finished wiper 304 advances one step and then extends earth over lead 249, front contact and armature 218, wiper 200, contact 254, terminal 255 on the right hand side of the I. D. F., terminal 256 on the left hand side of the I. D. F. to conductor 250 extending to the sixth contact in the bank of wiper 303 and said wiper, interrupter contact 324, magnet 323 to battery. Thus earth which is removed from the sixth contact in the bank of wiper 303 by the operation of armature 223 is now replaced at the proper time in order to cause the switch to advance through this position.

The exchange digits have now been disposed of and the sending of the numerical digits will proceed in precisely the same manner as has previously been described. On the succeeding step of the switch OCS, relay 319 is energized and serves to change over the circuits associated with relays 308 and 312, so that these relays shall work in conjunction with the registers $M^4$, $M^1$, $M^2$ and $M^3$ rather than with the switch IS. In each case the proper digit register advances until its upper wiper engages the contact connected to lead 167, each step of this return motion serving to send an impulse to the corresponding switch for extending the speaking connection, whereby as previously explained, the number of impulses sent is the complement of the number dialled by the calling subscriber. When all the numerical digits have been sent the output control switch is moved into its eleventh position and an impulse then comes back over lead 172 and wiper 120 of the switch ICS in eighth position, and thus serves to operate switching relay 33 in the trunk circuit TC. Thereupon the circuit of relay 31 is opened, and subsequently that of relay 32, and the deenergization of the latter relay opens the circuit for relay 81, whereupon the switch DS is restored to its normal condition, and the release of the register translator is initiated by the removal of earth from lead 93. This release proceeds in a manner precisely similar to that previously described, relay 217 being unlocked when wiper 141 passes off its multipled contacts during the return of the switch ICS to normal.

In order that the working of the invention may be fully understood, one further case of a connection set up by the subscriber at sub-station A will be briefly considered. Suppose in this case that the wanted number is Forest 3456 and that the numerical equivalent of the first three letters FOR of the exchange name is 307. Assume further that the Forest exchange is also situated at some distance from the originating exchange or is perhaps a satellite exchange and consequently that six exchange code digits are necessary in order to obtain access to it; thus the digits 307 dialled by the calling party may be translated into the digits 730413.

For convenience in description it will be taken that the initial operations of setting up the connection take place in the manner

previously described, that is to say, the subscriber's line switch C takes into use the trunk circuit TC of Fig. 1, and the register selector DS associated therewith again takes into use the register translator shown in Figs. 2, 3 and 4. The dialling of the first of the exchange digits 3 by the calling subscriber results in three earth impulses being sent over lead 94 and through relay 112 over wiper 120 to magnet 121 of the first digit register $M^1$.

In a similar manner the second digit 0 is recorded on the register $M^2$ and the third digit 7 on the register $M^3$. When the switch ICS now steps to its fourth position a circuit is again completed for the code switch CS shown in figure 3, since, as previously pointed out, this switch is enabled to deal with all exchanges for which the first digit is 2 or 3, that is to say, with the assumed lettering of the dial, those in which the first letter of the exchange name is A, B, C, D, E or F.

A study of the connections in Figs. 2 and 3 will show that the contacts which are now marked in the banks of the wipers 200, 201 and 202 of the switch CS are the contacts 256, 257 and 258. Consequently when the switch CS reaches this position, the shunt field relay 208 is energized as before and operates with the previously described results, which include the energization of relay 150. The registers $M^1$, $M^2$ and $M^3$ are thus returned to normal, and owing to the connection of earth to lead 180 by relay 150, the sending of impulses is initiated in the usual manner.

The determination of the value of the first series of impulses is effected by the earth connection by way of wiper 304 and its first contact over lead 330, front contact and armature 215, wiper 205, contact 259 to terminal 7 on the left-hand side of the I. D. F., and thence to the corresponding contact in the bank of wiper 326. Sending of impulses is effected by means of armature 302 in the usual way, and when the marked contact is engaged by wiper 326 relay 312 energizes to terminate the impulse train. Switch OCS is subsequently moved on one step and the second digit is then sent out, the determination of its value being effected over a circuit including wiper 204 which may readily be traced. Upon the termination of this series of impulses, the switch OCS again steps and a circuit is completed in the manner previously described for relay 217 and also for magnet 206. The code switch CS is thus advanced one step and relay 217 energizes with the previously described results. Wipers 202, 201 and 200 are now brought into use successively to control the sending of the fourth, fifth and sixth digits in the exchange code and the switch OCS is subsequently advanced to its seventh position. Relay 319 is now energized, thereby cutting out the switch IS and transferring the control of impulse generation to the register $M^4$. As in the previous case, the numerical digits 3456 dialled by the calling party are translated by the operation of the registers $M^4$, $M^1$, $M^2$, and $M^3$ into the digits 8765. When all the numerical digits have been sent, the release of the register translator is brought about in the manner above described in response to the switching impulse sent from wiper 304 over leads 172 and 94.

It will now be desirable to consider the function and operation of wiper 99 of the switch ICS and wiper 299 of the switch OCS, the contacts in the banks of these wipers being multipled together in a particular manner. These wipers are provided to take care of the case in which the subscriber is dialling in a slow or irregular manner, so that the register translator, in spite of having to wait for all the exchange digits before it starts sending, is likely to catch up with the subscriber. In cases of this sort it has sometimes been arranged that after the register translator has sent out all the digits received by it it is released and subsequent digits dialled by the subscriber operate the switches direct. One objection to this arrangement is that the switches may not always receive impulses of exactly standard character from the subscriber's dial while the impulses sent from the register translator can readily be adjusted to be standard. Another difficulty arises in the present case because the numerical digits are not sent out from the register translator exactly as received, but are so to speak inverted. A further point that requires attention is that since in this case impulses are generated by contacts on the magnets of the register switches and these contacts are short-circuited until the proper time by wiper 300 of switch OCS, it is essential that this switch OCS shall not move into the next sending position before the corresponding digit has been completely received, otherwise there will be a chance of false impulses being sent out prematurely while the register switch is recording the digit. By way of example, suppose a subscriber wanting Forest 3456 pauses after he has dialled FOR—3; in this case the number of digits sent in will be four and therefore switch ICS will be in position 5 and wiper 99 will be resting on contact 188. When the sender has sent out the six exchange selecting digits and has started sending the thousands digit, the switch OCS will be in seventh position. After the sending of the thousands digit is finished when relay 308 deenergizes and opens the circuit of relay 312 at armature 309, relay 312 does not deenergize if the subscriber still delays because a circuit is now completed from earth, wiper 99, contact 188, lead

189, seventh contact in the bank of wiper 299 and said wiper, winding of relay 312 to battery; hence relay 312 remains energized and at armature 316 maintains the circuit of magnet 323 so that the switch OCS cannot advance. Suppose now that the subscriber resumes his dialling, the digit 4 will be recorded on the register $M^1$ and on its termination wiper 99 will be advanced from the fifth to the sixth position. The circuit of relay 312 is thereupon opened and it deenergizes and permits OCS to advance to eighth position in which position the sending of the digit 4, which will be converted to 7 then takes place. Similar circuits are adapted to be completed as may be readily traced in cases where there are pauses between other digits. It is, of course, undesirable that the circuit of magnet 323 should remain closed an undue length of time, and this will be taken care of by arrangements of known type which are therefore not shown for releasing the register translator and giving the subscriber the busy tone in case he makes a pause of excessive length between digits.

It has become usual practice in automatic telephone systems to arrange that when the subscriber requires the services of an operator he dials the digit 0 only. The effect of this on the register translator of the present invention is that when the switch ICS steps to its second position on the termination of this digit, a circuit is completed from battery, second contact in the bank of wiper 141, armature 145 and its back contact, wiper 125, lead 190, winding of relay 260 to earth. No armatures have been shown on relay 260 but it will be understood that this is arranged to make suitable connections to effect the sending out of the series of impulses necessary to route the call to the operator's position. Arrangements will also be included for switching over and releasing the register translator as soon as the required impulses have been sent without waiting for the switch OCS to reach its eleventh position in which switching normally takes place.

It should be mentioned that arrangements will preferably be made for preventing the register translator being taken into use while any of the various switches are in an off normal position, but since such arrangements are by now well known they have not been shown in this instance. Similarly in order to avoid unduly complicating the drawing, full wiring of the banks on the switch CS has not been shown, but only sufficient to give a clear idea of the principle on which it is done.

It should be mentioned also that in order to avoid unnecessary rotation of the various switches, the ICS has been provided with three normal positions, and the switches $M^1$, $M^2$, $M^3$, $M^4$, OCS and IS with two. For the sake of convenience, however, it has been assumed throughout the description when referring to contacts that the switch starts from the position shown in the drawings. Clearly, if it were thought desirable, it could be arranged that the switches $M^1$, $M^2$, $M^3$, which in the ordinary course respond to two digits, were always returned to the position shown when the register translator was not in use.

Another point which it is desirable to mention is that since wiper 300 of the switch OCS is connected in the outgoing pulsing circuit, it is essential that this wiper shall not break contact in moving from one position to the next, otherwise false impulses would be sent out over the loop and the switches would be wrongly set. It will also be appreciated that though in the arrangement shown the switch CS moves on the additional step after it has controlled the sending of two digits, it would equally well be arranged to move at any other suitable time, for instance before any digits had been sent at all. Furthermore, if in some particular instance it should be desirable to send more than six code digits, it would be possible for the wipers such as 204 and 205 to control the transmission of series of impulses before taking the extra step and also after it as well.

What is claimed is:

1. In a director, a translator switch, wipers for positioning said switch, a sender, and means for altering the circuits of said switch after the same is positioned to enable the said wipers to be used for controlling said sender.

2. In a director, digit registers for registering digits of a called number, a translator switch, means for operating said switch to a certain position depending on the particular digits registered, means for thereafter operating said switch to a new position, and a sender controlled by said switch in its new position to send out digits.

3. In a director, digit registers for registering digits of a called number, a translator switch, means for operating said switch to a certain position depending on the particular digits registered, means for thereafter operating said switch a predetermined additional extent, and a sender controlled by said switch in both positions to send out digits.

4. In a director, digit registers for registering digits of a called number, a translator switch having wipers, means for starting the operation of said switch, means controlled by said wipers for stopping said switch in a certain position depending on the particular digits registered, means for then moving said wipers an additional extent, and a sender controlled by said wipers in their new position to send out digits.

5. In a director, digit registers for registering digits of a called number, a translator switch having test wipers and digit control wipers, means for starting the operation of said switch, means controlled by said test wipers for stopping said switch in a certain position depending on the particular digits registered, a sender controlled by said digit control wipers to send out a plurality of digits, means for then advancing the switch to a new position, and means whereby said sender is then controlled by said test wipers in their new position to send out other digits.

6. In a director, digit registers for registering digits of a called number, a translator switch having test wipers, digit control wipers, and another wiper, means for starting the operation of said switch, means controlled by said test wipers for stopping said switch in a certain position depending on the particular digits registered, a sender controlled by said digit control wipers to send out a plurality of digits, means controlled by said other wiper for advancing the switch to a new position, and means whereby the sender is then controlled by said test wipers and said other wiper to send out other digits.

7. In a director, digit registers, means for registering the first part of a called number on said registers, a translator switch, means for operating said switch in accordance with the digit combination registered, means for thereafter restoring said registers to normal, said first means then functioning to register the last part of a called number on said registers, a sender controlled by said switch to send a plurality of digits, means for causing said restoring means to again restore said registers to normal, and means controlled by said registers while the same are restoring to normal the second time for sending out another plurality of digits.

8. In a director, digit registers, means for registering the first part of a called number on said registers, for then restoring said registers to normal, and for then registering another part of the called number thereon, an impulsing circuit, a sender, means for causing said senders to send impulses over said circuit in accordance with the first setting of said registers, and separate sending means for each register for sending impulses over said circuit in accordance with the second setting of the associated register.

9. In a director, digit registers, means for registering a series of digits on said registers, for then restoring said registers to normal, for then registering a second series of digits thereon, and for then restoring said registers to normal a second time, a sender, means for causing said sender to send impulses in accordance with the first setting of said digit registers, and means controlled by said registers in restoring to normal the second time for sending other impulses.

10. In a director, digit registers, means for registering digits of a called number on said registers, a plurality of translators, means controlled by one of said registers for selecting a particular one of said translators depending on the digit registered thereon, means controlled jointly by said registers for operating the selected translator in accordance with the digit combination registered, and a sender for sending digits in accordance with the setting of the selected translator.

11. In a telephone system, a register for registering digits of a called number, a translator switch having a wiper, means including said wiper for positioning said switch in accordance with digits registered on said register, means controlled by said wiper for repositioning said switch under certain conditions, and a sender for sending digits controlled by said wiper in the first portion of the switch providing the switch is not repositioned, and controlled by said wiper in the second position of the switch providing the switch is repositioned.

12. In a telephone system, a translator switch having test wipers and digit control wipers, means including said test wipers for positioning said wipers in accordance with a called number, a sender controlled by said digit control wipers to send out digits, means controlled by one of said digit control wipers in case the number of digits to be sent out is greater than the number of digit control wipers for moving said wipers to a new position, and means for then placing said sender under the control of said test wipers to cause the sender to send other digits.

13. In combination, a translator switch, registering apparatus arranged to be set in accordance with a plurality of characters in a number, means for positioning said switch subsequent to the said setting of said registering apparatus and in accordance with the setting of said registering apparatus, means for thereafter moving said switch an additional extent, and a sender controlled by said switch in its final position.

14. In combination, a translator switch, registering apparatus, means for operating said apparatus to register a plurality of characters in a number, means for subsequently positioning said switch in accordance with the setting of said apparatus, means for thereafter moving said switch an additional extent, and a sender controlled by said switch in both positions.

15. In a telephone system, a translator switch having wipers, means for starting the movement of said wipers, means controlled by said wipers when they reach a position corresponding to a called number

for stopping the movement of said wipers, means for then causing said wipers to be moved an additional extent, and a sender controlled by said wipers in their second position.

16. In a telephone system, a translator switch, means for initially positioning said switch in accordance with a called number, a sender controlled by said switch in its initial position to send digits, means operative after a certain number of digits have been sent for repositioning said switch to a new position, said sender being thereafter controlled by said switch in its second position to send other digits.

17. In a telephone system, a digit register comprising a wiper and a motor magnet, means for operating said magnet to position said wiper in accordance with a digit, a circuit interrupter, a control switch having two wipers and a two-step relay, the first control switch wiper being normally connected to said relay in series with said interrupter, means for operating said control switch wipers to connect with said register wiper and said motor magnet, respectively, to cause said two-step relay to operate to its first step when the circuit is closed by said interrupter, and to operate to its second step when said circuit is again opened by said interrupter, and means controlled by said two-step relay when it is operated in its second step for closing a circuit including said register wiper, the first control switch wiper, said interrupter, said second switch wiper, and said motor magnet in series to cause said digit register to restore said register wiper to normal.

In witness whereof, I hereunto subscribe my name this 31st day of August, A. D. 1925.

FRANK TENCH.