June 2, 1931. R. G. RICHARDSON 1,808,574

TELEPHONE SYSTEM

Original Filed Nov. 10, 1926 3 Sheets-Sheet 1

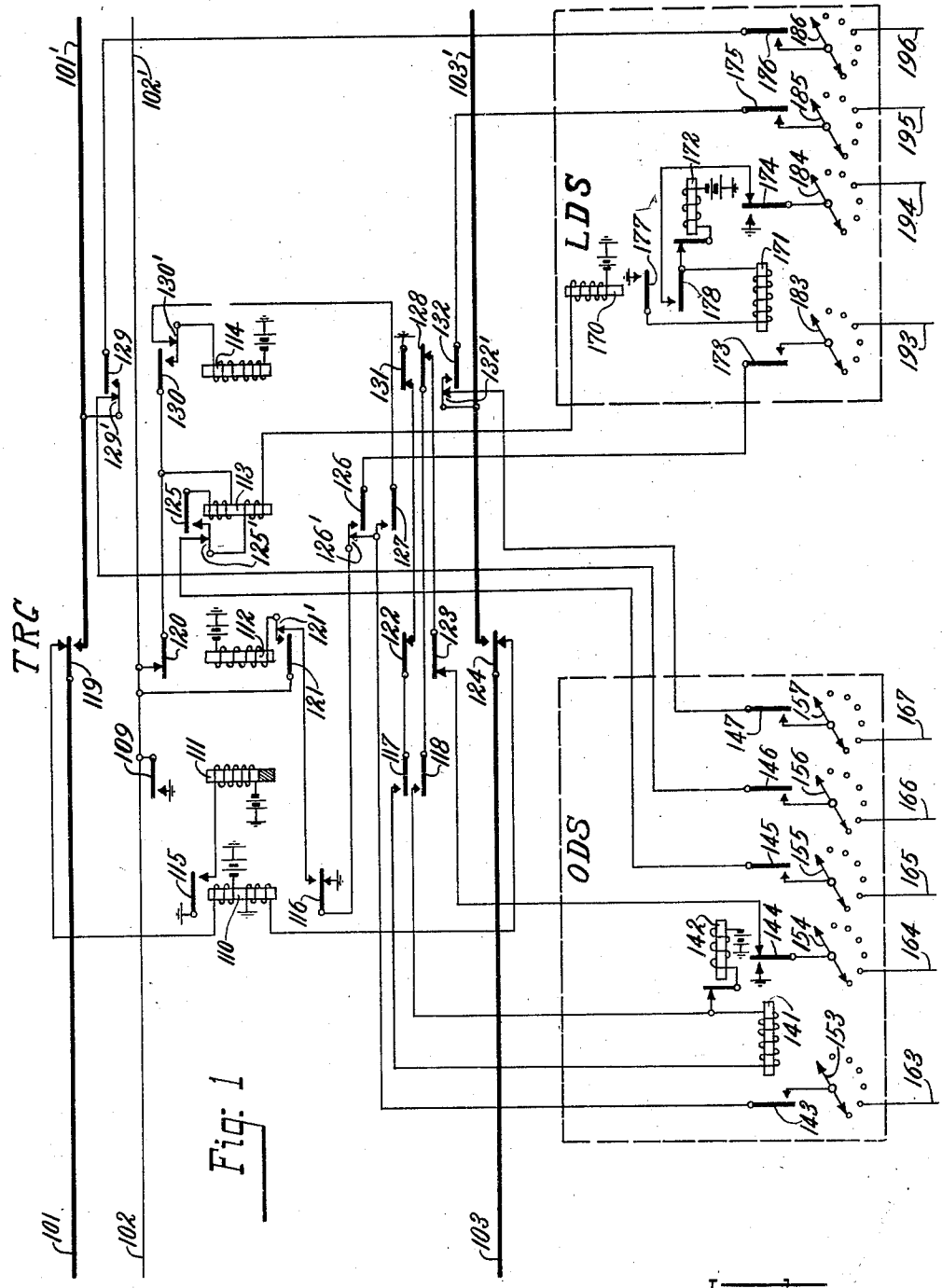


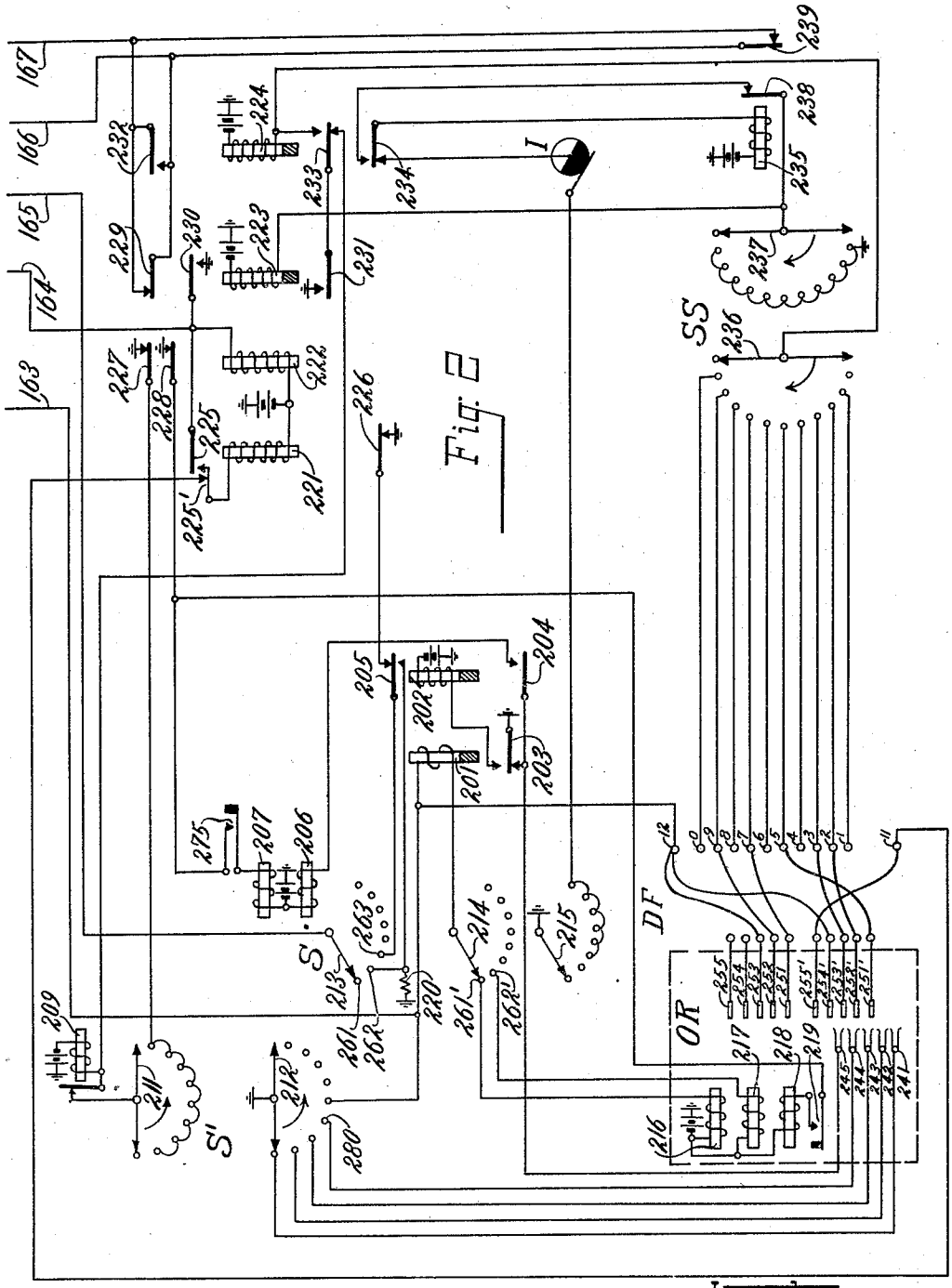
Fig. 1

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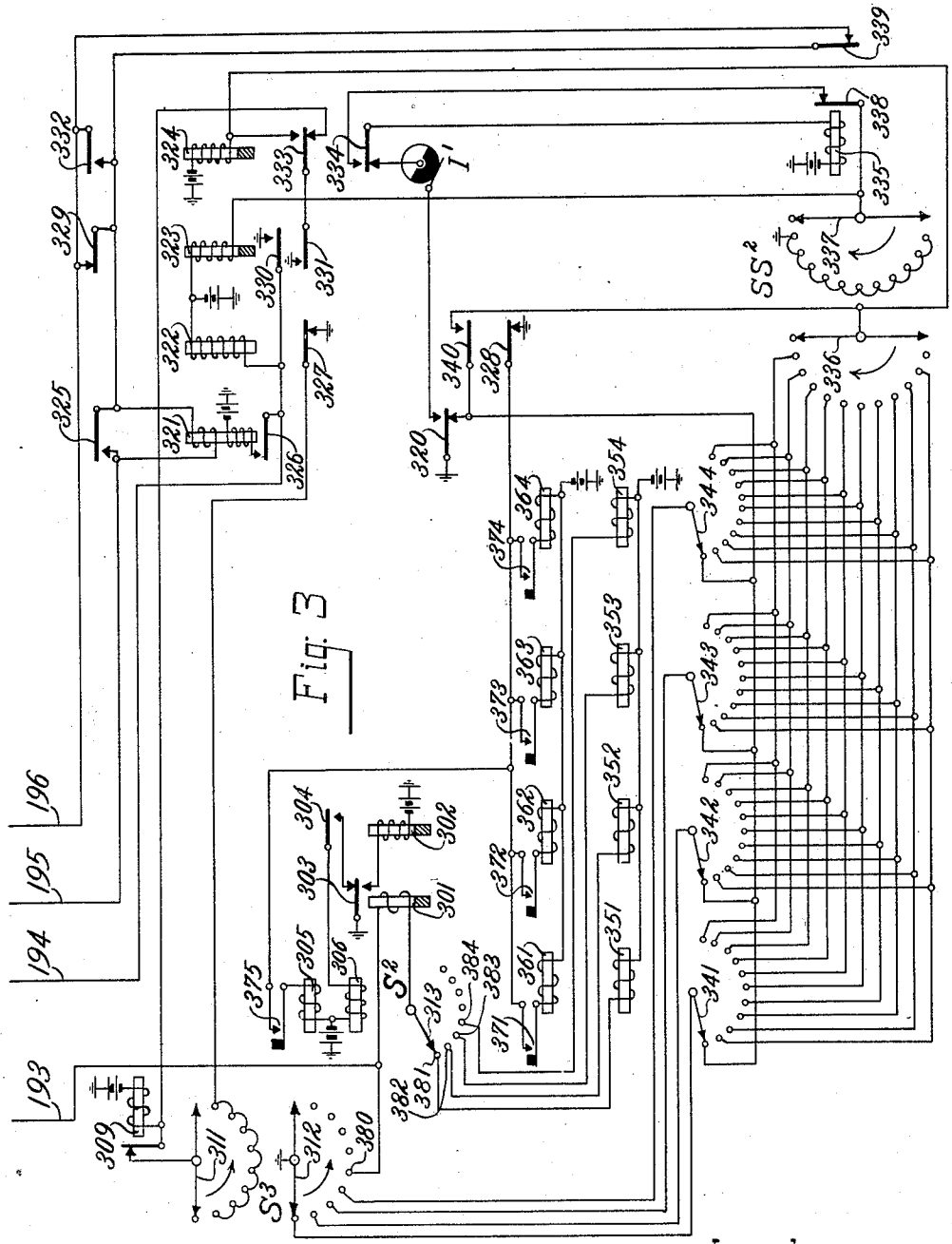
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TELEPHONE SYSTEM

Original Filed Nov. 10, 1926 3 Sheets-Sheet 3



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1,808,574

UNITED STATES PATENT OFFICE

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TELEPHONE SYSTEM

Application filed November 10, 1926, Serial No. 147,418. Renewed August 11, 1930.

This invention relates to telephone systems in general, but is more particularly concerned with automatic telephone systems in which register senders or directors are used to register called numbers and route the calls to their destinations.

Considering, for example, multi-office telephone system with a six digit numbering system employing directors of the ordinary or more common type, when a call is initiated, an idle one of a group of directors is taken into use by means of a non-numerical selecting switch, and the called number, as dialed by the calling subscriber is registered thereon. The first two digits or letters of the number, designating the office serving the called subscriber, are registered on the office register of the director, while the remaining digits of the number, designating the line in that office, are registered on the digit registers of the director. The director, in turn, sends out an office code to route the call to the office serving the called subscriber and then sends the line designating digits as registered on the digit registers. Upon completion of these operations, the director releases and may then be taken into use to extend another connection.

The same operations take place when an operator, such as the information operator, long distance operator, etc., whose call number comprises no more than two digits, is called, except that in this case none of the digit registers are used.

The object of this invention is the provision of a separate "office director", comprising an ordinary office register and a translating and sending mechanism for registering the office designation of a called number and transmitting the office code, and a separate "line director", comprising the ordinary digit registers and also a sending mechanism for registering and retransmitting the line designating digits.

According to the invention, a group of directors of each type is made accessible to separate director selectors, and in extending a connection, an idle one of each type of director is taken into use only for the length of time needed to perform its operations. More specifically, in a system employing separate office directors and line directors as introduced by this invention, when a call is initiated, an idle one of a group of office directors is taken into use by means of an office director selector and the office designation as dialed by the calling subscriber is registered thereon. Before the last digit or letter of the office designation has been registered, an idle one of a group of line directors is taken into use by means of a line director selector. If the call is for one of the special operators, whose call number comprises no more than two digits or letters, the line director is released again as soon as the second digit or letter is registered. Thus, the line director is held only for the length of time necessary to dial one digit, if the type of call is such as not to require a line director. If the call is for a regular subscriber, the line director taken into use is not released, and the line designating digits are registered on the digit registers of the line director. At the same time that the line designating digits are being registered, the office director transmits the office code, and upon completion thereof, the office director is released and may then be taken into use to extend another call. Thus, the office director is held only for the length of time necessary to register the office designating digits and transmit the office code. The line director transmits the line designating digits as registered, at the completion of which it is released and may then be taken into use to extend another call.

According to the above description, it is evident that the holding time of the office director is considerably less than the holding time of an ordinary director, since it is released immediately following the transmission of the office code. Also, the holding time of the line director is less than the holding time of the ordinary director, since it is not taken into use until just before the last digit or letter of the office designation is registered, and therefore is not held during the usual pause that follows the removal of the receiver and before the subscriber commences dialing. This interval occasionally is very long for reasons such as a subscriber failing to look up the telephone number until after he has re-

moved his receiver. Furthermore, no line director is used in a call to a special operator, except for the instant necessary to determine the type of call. As a result, only the minimum amount of director equipment is held in use at any one time. Obviously then, by using separate office directors and separate line directors as introduced by this invention, considerably less director equipment is needed in any given exchange system than would be needed if directors of the ordinary type were used.

Attention is also called to the fact that in any telephone system, in spite of all that is done to prevent it, grounded lines, short circuited lines, etc., occur and temporarily hold equipment out of service, such equipment including directors when they are used. In a system using separate office directors and separate line directors according to the present invention, only the office directors, which are smaller and less expensive than ordinary directors, can be temporarily held out of service by reason of a line being grounded or short circuited. Thus the amount of added director equipment ordinarily necessary to meet such contingencies is reduced.

The invention, its features as outlined above and its operation, will be described in detail with the aid of the annexed drawings, comprising Figs. 1–3, inclusive, which show by means of the usual schematic circuit diagrams the new and improved directors and the principal apparatus associated therewith. To understand the relation of the drawings, Fig. 3 should be placed to the right of Fig. 2, and Fig. 1 should be placed above Figs. 2 and 3 with the corresponding lines in alignment. In this particular embodyment of the invention the directors as shown are for use in a six digit system in which a subscriber's number comprises two office designating digits or letters and four line designating digits. The principle of the invention may of course be carried out for any size system. Since it is immaterial whether the office designation in the directory numbers comprises letters or digits, the letters only representing certain digits, the office designation in the following descriptions will be referred to as comprising two digits.

In Fig. 1 of the drawings, the trunk line comprising conductors 101, 102, and 103 is shown with its associated trunk relay group TRG, its individual office director selector ODS, and its individual line director selector LDS. This trunk is one of a plurality of trunks similarly equipped which are accessible in the banks of preselectors or subscribers' individual lineswitches, and which terminate in automatic switches such as, for example, first selectors of the Strowger vertical and rotary type.

In the banks of the office director selector ODS, as well as in the banks of other similar office director selectors multiply connected with the banks of the office director selector ODS, access is had to a group of office directors, one of which is shown in Fig. 2. In the banks of the line director selector LDS, as well as in the banks of other similar line director selectors multiply connected with the banks of the line director selector LDS, access is had to a group of line directors, one of which is shown in Fig. 3. Mechanically, and in principle of operation, the office director selector ODS and the line director selector LDS are of the well known rotary type of non-numerical selecting switch.

It is understood, that in a larger system, a seven digit system for instance, the office director selector becomes a numerical selecting switch upon which the first digit of the office designation is dialed, as is disclosed in the copending application of R. G. Richardson, et al., Serial No. 547,866, filed March 29, 1922.

The office director shown in Fig. 2 comprises essentially a two motion office register OR upon which the office designating digits are registered, a sequence switch S for controlling the operation of the office register and the starting of the sending of the office code, a sender switch SS for sending the office code, a distributing frame DF upon which the office designating digits are translated, a sequence switch S′ for controlling the sending of the digits of the office code in their proper sequence, the constantly rotating interrupter I for operating the sender switch SS, and various controlling relays.

It should be mentioned that in a smaller system such as in a five digit system wherein only one digit designates the office, to which the principle of the invention is also applicable, the office register of the office director would be only a single motion switch.

The line director shown in Fig. 3 comprises essentially four digit registers upon which the line designating digits are registered, a sequence switch S^2 for controlling the operation of the digit registers, a sender switch SS^2 for sending the line designating digits, a sequence switch S^3 for controlling the sending of the line designating digits in their proper sequence, the constantly rotating interrupter I′ for operating the sender switch SS^2, and various controlling relays.

The mechanical construction of the various parts of the director is like that of corresponding parts of the ordinary director known in the art and therefore need not be further described.

With this general description of the features of the invention and the results to be attained in mind, a further understanding and appreciation of the invention may be gained from a detailed description of the operation of the apparatus used in setting up the various possible kinds of connections. For this purpose it will first be assumed that some

subscriber, served by the exchange in which the apparatus shown in the drawings is located, desires connection with some other subscriber in the system. To initiate the call, the calling subscriber removes his receiver and then dials the digits of the directory number of the subscriber with which he wishes to converse.

Responsive to the removal of the receiver at the calling station, the calling subscriber's individual lineswitch operates to select an idle trunk. It may be assumed that the trunk selected is the one comprising conductors 101, 102, and 103. When this trunk is seized, a circuit is established for the line relay 110 of trunk relay group TRG, which circuit includes the trunk conductors 101 and 103 and the bridge at the calling station in series. Relay 110 operates and closes a circuit for release relay 111 at armature 115. Relay 111 energizes and grounds the release conductor 102 at armature 109, closes a circuit for the switching relay 141 of the office director selector ODS at armature 117, and at armature 118 closes the stepping circuit for magnet 142, at the same time short circuiting switching relay 141, providing the wipers of the office director selector ODS are in engagement with the bank contacts associated with a busy director, in which case ground potential will be present on the bank contact engaged by test wiper 154. Magnet 142 then operates in a buzzer-like manner to advance the wipers 153–157, inclusive, until an idle director is reached, which may be assumed to be the one accessible by way of conductor 163–167 inclusive. When this director is connected with, its idle condition being indicated by the absence of ground on conductor 164 connected to the bank contact now engaged by wiper 154, magnet 142 ceases to operate and the short circuit is removed from switching relay 141. Switching relay 141 then operates and performs the following circuit changes: at armature 143 the impulsing circuit over which the office designating digits are to be sent to the office register is prepared. At armature 144 ground potential is placed on the test contact to which conductor 164 is connected and on the test contacts of other office director selectors multiply connected therewith to mark the office director in question busy, at the same time closing a circuit for release relay 222 of the office director. Relay 222 operates and opens points in the release circuits of release magnets 218 and 207 at armature 228 and opens a point in the return stepping circuit of magnet 209 at armature 227. At armature 145 of relay 141 a start circuit is prepared for line director selector LDS as will be described presently. At armatures 146 and 147 a bridge is closed across trunk conductors 101′ and 103′, this bridge including springs 129′ and 132′ controlled by armatures 129 and 132, respectively, armatures 146 and 147, wipers 156 and 157, conductors 166 and 167, shunt springs 229, and impulsing springs 239. By reason of this bridge across conductors 101′ and 103′, the line relay and release relay of the selector switch terminating these conductors are operated in the usual manner to prepare this selector for operation.

Responsive to the dialing of the first digit of the called number, line relay 110 operates in the usual manner and sends a corresponding number of ground impulses over a circuit including resting contact and armature 116, springs 126′, armature 143, wiper 153, conductor 163, winding of series relay 201, wiper 214 of sequence switch S, bank contact 261′, winding of vertical magnet 216 to battery. Vertical magnet 216 operates and raises the wipers 241–245, inclusive, of the office register OR opposite the level of bank contacts corresponding to the digit dialed. Series relay 201 operates in series with magnet 216, and due to its slow acting characteristic maintains its armature 203 operated during the transmission of this series of impulses, closing a circuit for relay 202. Relay 202 operates and prepares a circuit described later. At the termination of this series of impulses, relay 201 deenergizes and breaks the circuit of relay 202. Relay 202 is slow-acting, however, and it follows that a circuit is closed momentarily for stepping magnet 206 of sequence switch S, this circuit including armature 204 and armature 203. Magnet 206 operates and steps the switch wipers 213, 214, and 215 in engagement with the next set of bank contacts. Wiper 214, on moving to its second position, shifts the incoming impulsing circuit from the vertical magnet of the office register to the rotary magnet, so as to prepare for the receipt of the next series of impulses.

The operation of the sequence switch S also brings about the selection of an idle line director, and for convenience this operation will now be explained. The engagement of wiper 213 with bank contact 262 closes a circuit which may be traced from ground through resistance 220, bank contact 262, wiper 213, conductor 165, wiper 155, armature 145, springs 125′ controlled by armature 125 through the lower winding of receiving-transfer relay 113, through the winding of start relay 170 of the line director selector LDS to battery. Due to the resistance 220 in this circuit, the current flow is insufficient to cause the operation of relay 113. Relay 170 operates, however, and at armature 177 closes a circuit for switching relay 171, and at armature 178 closes an operating circuit for stepping magnet 172, at the same time short-circuiting relay 171 providing the wipers of line director selector LDS are standing on the bank contacts associated with a busy line director in which

case ground potential will be present on the bank contact engaged by test wiper 184. Stepping magnet 172 then operates in a buzzer-like manner to advance the switch wipers 183–186, inclusive, until an idle line director is reached. When an idle line director is reached, for example, the one accessible by way of conductors 193–196, inclusive, its idle condition being indicated by the absence of ground potential on conductor 194 connected to the bank contact now engaged by wiper 184, the operation of stepping magnet 172 ceases and the short circuit around relay 171 is removed. Switching relay 171 operates and performs the following circuit changes: at armature 173 the impulsing path over which the line designating digits will be sent to the line director is prepared. At armature 174 ground potential is placed on the test contact to which conductor 194 is connected and on the test contacts of other line director selectors multiply connected therewith to mark the line director in question busy. At armatures 175 and 176 a bridge is prepared which is to be substituted for the first applied bridge across conductors 101′ and 103′ after the office code has been transmitted by the office director as will be described fully presently. The application of ground potential to conductor 194 also closes a circuit for release relay 322, which operates and opens points in the return-to-normal circuit of sequence switch S^3 and in the release circuit of the digit registers at armatures 327 and 328, respectively. The engagement of armature 340 and its working contact at this time closes a circuit for relay 324, this circuit including armature 320 and the resting contact. The function of the operation of relay 324 will be fully described hereinafter.

Responsive to the dialing of the next digit, which in this particular case is the last office designating digit, line relay 110 again responds and sends a corresponding number of ground impulses over the same path as previously traced to wiper 214 which now is in engagement with contact 262′, through the rotary magnet 217 to battery. Rotary magnet 217 operates responsive thereto and rotates the wipers 241–245 into engagement with the corresponding set of bank contacts of the selected level, which may be assumed to be contacts 251–255, inclusive. Relay 201 again operates this time in series with rotary magnet 217 and again closes a circuit for relay 202. Relay 202 energizes as before. At the termination of this series of impulses, relay 201 deenergizes and again closes a circuit for the stepping magnet 206, which operates and moves the switch wipers 213, 214, and 215 into engagement with the third set of bank contacts. The advance of wiper 215 to its third position starts the office director to send out the office code, but further explanation of this operation will be deferred pending the explanation of the transfer of the impulsing circuit to the line director, which is brought about by the movement of wiper 213 to its third position.

Shortly after the opening of the circuit of relay 202 by the deenergization of relay 201, relay 202 deenergizes and causes the application of direct ground potential to conductor 165 by way of the resting contact and armature 226, resting contact and armature 205, bank contact 263, and wiper 213. The increase in current flow through the lower winding of relay 113, Fig. 1, is sufficient to cause the operation of relay 113. This relay, in operating, closes a locking circuit for itself in series with its lower winding at armature 125, this locking circuit extending to release conductor 102 by way of armature 120 and the resting contact; at the same time, springs 125′ are separated. At armature 126 and the working contact the impulsing path is extended to the line director shown in Fig. 3. At the same time, by the separation of springs 126′, the impulsing path extending to the office director shown in Fig. 2 is disconnected. At armature 127 a circuit is prepared for sending transfer relay 114 to be described presently.

For the sake of example, the office code to be sent to route the call to the office serving the calling subscriber is assumed to be 79. At the distributing frame DF, the terminal connected to bank contact 251 is cross connected to the right hand terminal No. 7. The terminal connected to bank contact 252 is cross connected to the right-hand terminal No. 9; and since there are no more code digits to be sent, the terminal connected to bank contact 253 is cross connected to the right-hand terminal No. 12, this being the switching-through terminal. By the engagement of wiper 215 with the third contact in its bank, ground potential is connected to the brush of the constantly rotating interrupter I. The circuit of stepping magnet 235 of the sender switch SS is now intermittently opened and closed at the predetermined rate at which impulses are to be sent to the automatic switches. Responsive to the first operation of magnet 235, wipers 236 and 237 are moved into engagement with the first set of bank contacts in their respective banks. A circuit is then established for relay 223, this circuit including wiper 237 and its first bank contact. Relay 223 operates and opens the shunt around impulsing springs 239 at armature 229; closes an energizing circuit for stepping magnet 209 of sequence switch S′ at armature 231, at the same time preparing a holding circuit for stop relay 224; and closes another circuit for release relay 222 at armature 230 to insure the holding of the office director until the completion of the transmission of a complete digit. Upon

the next operation of magnet 235, the bridge across the outgoing trunk conductors 101′ and 103′ is opened at impulsing springs 239, and wipers 236 and 237 are moved into engagement with the next set of contacts in their respective banks. Magnet 235 continues to operate in this manner, each time opening the bridge across the outgoing conductors at springs 239, until wiper 236 engages the bank contact connected to the right-hand terminal No. 7 of distributing frame DF. When wiper 236 reaches this contact, a circuit is closed which may be traced from ground by way of wiper 212 of sequence switch S′, and its first bank contact, wiper 241, bank contact 251, terminal No. 7, wiper 236, winding of stop relay 224 to battery. Relay 224 operates and places a shunt around impulsing contacts 239 at armature 232; closes a holding circuit for itself at armature 233, at the same time opening the energizing circuit of magnet 209; and closes a self interrupting circuit for magnet 235 at armature 234 and the working contact. Magnet 235 now operates in a buzzer-like manner to step the wipers 236 and 237 to their normal position (the position shown), whereupon the self-interrupting circuit is opened, wiper 237 engaging its ungrounded normal contact. Wiper 237, in engaging its ungrounded normal contact, also opens the circuit of relay 223. Furthermore, magnet 209, in deenergizing, moves the wipers 211 and 212 into engagement with the next set of bank contacts.

Responsive to the seven interruptions in the bridge across conductors 101′ and 103′, the selector switch terminating these conductors operates in the well known manner to extend the connection to the next switch.

Relay 223, in restoring, opens the holding circuit of relay 224 at armature 231, and also closes a normal shunt around impulsing springs 239 at armature 229 and the resting contact. By reason of the slow acting characteristics of both relays 223 and 224, sufficient time is allowed for the operated selector to perform its selecting operation and for the succeeding switch to prepare itself to receive the next series of impulses. After the elapse of this interval, relay 224 deenergizes and again connects the interrupter I to the magnet 235. Magnet 235 again responds as described before, this time causing nine interruptions in the bridge across the trunk conductors 101′ and 103′. Relay 223 operates when wiper 237 engages its first bank contact to start the sending of impulses by disengaging armature 229 from its resting contact, and stop relay 224 operates when wiper 236 engages the contact connected to terminal No. 9 on the distributing frame DF to stop the sending of impulses by shunting the impulsing contacts 239 at armature 232. The circuit for operating stop relay 224 this time includes wiper 212 now in engagement with its second bank contact, wiper 242, bank contact 252, and terminal No. 9. Relay 224, on energizing, locks itself, closes a circuit for returning switch SS to normal, and opens the circuit of magnet 209 of the sequence switch S′. Magnet 209 accordingly deenergizes and moves the wipers 211 and 212 into engagement with the third set of bank contacts.

Responsive to the nine interruptions in the bridge across conductors 101′ and 103′, the selector switch, to which the connection was extended by the precedingly operated switch, operates, and further extends the connection via a repeater to the office serving the called subscriber.

The office director has now completed its function of sending the office code and so is released and restored to normal. The operations performed in connection with release and restoration of the office director will now be described. When wiper 212 is moved into engagement with the third contact in its associated bank, a circuit is closed which may be traced from ground by way of wiper 212 and its third bank contact, wiper 243, bank contact 253, right-hand terminal No. 12, conductor 163, wiper 153, armature 143, armature 127, springs 130′, controlled by armature 130, through the winding of sending-transfer relay 114 to battery. Relay 114 operates and performs the following circuit changes: at armatures 129 and 132 the bridge including impulsing springs 339 and conductors 195 and 196 is substituted for the bridge including impulsing springs 239 and conductors 166 and 167, the latter bridge being disconnected by the opening of springs 129′ and 132′. At armature 131 the circuit of switching relay 141 of office director selector ODS is opened, causing this relay to deenergize and release its armatures. At armature 128 a point in the stepping circuit of magnet 142 is opened to prevent its operating again before the present call is terminated. At armature 130 relay 114 closes a holding circuit for itself to release conductor 102, the circuit including armature 120 and the resting contact.

Relay 141, in releasing its armatures, restores the office director selector ODS to its normal condition, the wipers remaining in position on the previously selected contacts.

When relay 141 falls back, it disconnects ground potential from release conductor 164, thereby marking the office director idle and opening the circuit of release relay 222. Relay 222 deenergizes and by restoring its armatures to normal, closes the return stepping circuit of magnet 209 and closes the circuit for release magnets 207 and 218, off-normal springs 275 and 219 having closed upon the first step of switch S and office register OR, respectively. Magnets 209, 207, and 218 then operate and restore the office director to normal.

At this point attention is directed to a particular feature of the above operations. In the ordinary director comprising both an office register and digit registers, and one sequence switch for controlling the sending of the digits of the office code and the line designating digits, when the office code that is sent comprises less than the maximum number of digits, means must be provided for causing the sequence switch to skip or pass over the unused positions in its bank after the last code digit is sent and move over to the position in which the first line designating digit is sent. In the present arrangement of utilizing one director for sending the office code and another director for sending the line designating digits, such a provision is made unnecessary. Instead, since the sequence switch S′ controls only the sending of the office code, provisions have been made whereby the release of the office director and the sending operation of the line director is initiated by the sequence switch S′ in its next normal step following the sending of the last office code digit, regardless of which contact in its bank it is then moved to. This is accomplished by providing the switching-through terminal No. 12 on the distributing frame DF to which the bank contact succeeding the one that determined the last digit of the code is connected. For instance, in the above described connection, only two code digits were sent, and ground potential was applied to impulsing conductor 163 to initiate the release of the office director and the sending operation of the line director by way of wiper 212 in engagement with its third bank contact, wiper 243, contact 253, and terminal No. 12. Obviously, if the maximum number of code digits are sent, in this case four, ground potential is applied to conductor 163 to initiate the said operations by way of wiper 212 and the fifth contact directly.

Usually, in setting up a connection, the calling subscriber dials the digits of the called number, one digit after another, as quickly as is conveniently possible. Thus, the registration of the line designating digits is taking place while the office director sends out the office code as just described. The operations which take place in the line director will now be described. It will be recalled that the impulsing path was transferred to the line director by the operation of relay 113 immediately after the registration of the second digit.

Responsive to the third digit dialed by the calling subscriber, line relay 110 operates and sends a corresponding number of ground impulses over the path by way of resting contact and armature 116, working contact and armature 126, working contact and armature 173, wiper 183, conductor 193, through the winding of series relay 301, wiper 313 of sequence switch S^2, bank contact 381, through the winding of stepping magnet 351 to battery. Magnet 351 operates and sets the register wiper 341 on the contact in its bank corresponding to the digit dialed. Series relay 301 energizes in series with magnet 351 and at armature 303 closes a circuit for relay 302. Relay 302 operates and prepares a circuit for stepping magnet 306 at armature 304. At the termination of this series of impulses, relay 301 deenergizes and opens the circuit of relay 302. Relay 302 is slow-acting, however, so a circuit is momentarily closed for stepping magnet 306. Magnet 306 operates and sets the switch wiper 313 into engagement with bank contact 382. Wiper 313, on moving into engagement with bank contact 382, shifts the incoming impulsing circuit from register magnet 351 to register magnet 352, so as to prepare for the receipt of the next series of impulses. The remaining three digits of the called number, as dialed by the calling subscriber, are then registered on the other three registers, wipers 342, 343, and 344 being positioned on the contact in their respective banks corresponding to the three digits, respectively. Wiper 313 of switch S^2, it will be understood, is advanced one step after each series of impulses, so as to associate the impulsing circuit with the operating magnets of the registers successively.

The starting of the sending of the line designating digits is governed by the start relay 321. The upper winding of this relay is initially included in the bridge which as will be recalled is placed across the trunk conductors 101′ and 103′ after the office code has been sent by the office director, which usually takes place some time after one or more of the line designating digits have been registered depending on the rapidity with which the calling subscriber dials these digits. As soon as the second bridge is placed across the trunk conductors 101′ and 103′, relay 321 operates and closes a locking circuit for itself to the grounded conductor 194 at armature 326, at armature 325 short-circuits its upper winding, and at armature 320 places ground potential on the brush of the constantly rotating interrupter I′, at the same time opening the circuit of stop relay 324, provided at least one digit has been registered. Relay 324 deenergizes a short time after its circuit is opened, allowing time for the selecting operation of the selector operated by the last office code digit, and at armature 334 and the resting contact connects the interrupter I′ to stepping magnet 335. Interrupter I′ is now effective to intermittently open and close the circuit of stepping magnet 335 of sender switch SS^2. The operation of the sender switch SS^2 and the controlling relays 323 and 324 is identical with the operation of sender switch SS and controlling relays 223 and 224,

so a description of the operation thereof need not be repeated. The sender switch SS^2 operates to send out the four digits registered on the digit registers, the order in which the digits are sent being controlled by the sequence switch S^3, the operation of which is the same as the operation of sequence switch S'.

It should be mentioned that in this line director the same method for preventing the sending operation from getting ahead of the registration of the digits as dialed is employed as has been used in other directors. This method, as shown, consists in providing multiple circuits including each of the register wipers and their respective normal contacts for holding the stop relay 324 energized in case the sequence switch is in position to cause the sending of a digit which digit is not yet registered, that is, the register wiper corresponding to that digit is still in normal position. Relay 324 is held, then, until the next digit is registered and being slow-acting, delays the starting of the sending switch an interval to insure against the sending switch overtaking the register wiper.

After the sending of the final digit, sequence switch S^3 operates and advances wiper 312 into engagement with bank contact 380 which initiates the release and restoration of the line director to normal as follows: the engagement of wiper 312 with bank contact 380 closes a circuit, which may be traced from ground by way of wiper 312, bank contact 380, conductor 193, wiper 183, armature 173, armature 126 and the working contact, armature 116 and the working contact, normally closed springs 121', through the winding of switching relay 112 to battery. Switching relay 112 operates to perform the following circuit changes: at armature 121, relay 112 closes a locking circuit for itself to release conductor 102. At armatures 122 and 123 additional points in the circuit of relays 141 and 142 are opened. At armature 120 the holding circuits for relays 113, 170, and 114 are opened, causing these relays to restore their armatures to normal. At armatures 119 and 124 trunk conductors 101 and 103 are connected to trunk conductors 101' and 103', respectively, after which relays 110 and 111 deenergize and restore their armatures to normal.

Relay 170, in releasing its armatures, opens the stepping circuit for magnet 172 and opens the circuit of switch relay 171. Relay 171 in releasing its armatures, restores the line director selector LDS to its normal condition, the wipers remaining in position on the contacts previously selected, at the same time freeing the line director by removing ground potential from conductor 194. This also opens the circuit of the release relay 322. Relay 322, in deenergizing, closes the self interrupting circuit for stepping magnet 309 at armature 327, and closes the circuits for release magnets 305, 361, 362, 363, and 364 at armature 328, off-normal springs 371–375, inclusive, having closed upon the first movement of the switch or register with which each is associated. Magnet 309 operates intermittently until wipers 311 and 312 are again restored to their normal positions as shown. Magnets 305 and 361–364 operate to restore their respective switch or register wipers to normal.

Responsive to the digits sent out by the line director, automatic switches in the office to which the connection has been extended are operated in the well known manner to extend the connection to a succeeding switch, the last switch operating responsive to the last two digits to extend the connection to the called line, signal the called subscriber, and finally complete the connection when the called subscriber answers.

At the termination of the conversation, both subscribers replace their receivers. The replacement of the receiver by the calling subscriber initiates the release of the operated automatic switches in the usual and well understood manner. Removal of ground from conductor 102 opens the holding circuit for switching relay 112. Relay 112 then deenergizes and restores its armatures to normal.

According to this invention, a line director, which is seized after one of the digits of a called number is dialed, is released again as soon as it is determined that the call is for a special operator whose call number consists of only one or two digits, therefore not requiring the line director. The manner in which this is accomplished will now be described. For this purpose it will be assumed that a calling subscriber wishes connection with one of the special operators whose directory call number comprises only two digits. Responsive to the removal of the receiver at the calling station, the subscriber's individual line switch again operates to seize a trunk line, which will again be assumed to be the trunk line comprising conductors 101 to 103. Line relay 110, and release relay 111 again operate, and as described cause the office director selector ODS to select and connect with an idle office director, which again will be assumed to be the office director shown in Fig. 2. The two digits of the called number as dialed by the calling subscriber are again registered on the office register OR by the operation of the vertical and rotary magnets by positioning the wipers 241–245 into engagement with the corresponding set of bank contacts, which will be assumed to be bank contacts 251' to 255'. Again the line director selector is operated after the dialing of the first digit to select an idle line director. The bank contact 255', as well as the corresponding bank contacts of all other sets corresponding to the number of other

special operators, is cross connected to terminal No. 11 on the distributing frame DF which is connected by way of normally closed contacts 225′ to the line director release relay 221. At the termination of the dialing of the second digit of the called number, relay 201, having operated in series with rotary magnet 217, deenergizes, and as previously described closes a circuit for stepping magnet 206, and in this case also closes a circuit which may be traced from ground by way of armature 203 and the resting contact, wiper 245, bank contact 255′, terminal No. 11, springs 225′ through the winding of relay 221 to battery. Relay 221 operates and closes a locking circuit for itself at armature 225 and the working contact, at the same time opening its initial energizing circuit by separating springs 225′, and at armature 226 disconnects direct ground potential from the resting contact of armature 205, the purpose of which will be described presently. The deenergization of relay 201 also opens the circuit of relay 202 which shortly thereafter deenergizes and releases its armatures.

Referring to the description of the previously described connection, it will be remembered that relay 113 of the trunk relay group TRG was operated after the dialing of the second digit due to an increased current flow in its lower windings by the connection of direct ground potential to conductor 163 when armature 205 engaged its resting contact. In the present connection the circuit of the lower winding of relay 113 in series with relay 170 of the line director selector is opened as soon as armature 205 disengages its working contact, since relay 221 is now energized. Thus relay 113 is not energized, and furthermore, relay 170 is deenergized. Relay 170 releases its armatures and opens the circuit of switching relay 171 which in turn deenergizes and restores its armatures to normal, thereby releasing the line director that was taken into use after the dialing of the first digit.

As soon as the two digits of the called number are registered, the sender switch SS again operates to transmit the proper code to route the connection to the desired special operator. As soon as the office code has been sent, which in this case has been assumed to be the three digits five, two, and three, as indicated by the cross connections on the distributing frame DF, a circuit is closed which may be traced from ground by way of wiper 212, bank contact 280, wiper 244, bank contact 254′, switching through terminal No. 12, conductor 163, wiper 153, armature 143, closed springs 126′, armature 116 and the working contact, closed springs 121′, through the winding of switching relay 112 to battery. Relay 112 operates its armatures, closes a locking circuit for itself and connects conductors 101 and 103 to conductors 101′ and 103′, respectively, as before, and this time opening the circuit of relay 141 (relay 114 being deenergized) causing the restoration of the office director selector ODS and the release of the office director as previously described.

This completes the description of the features and operation of the invention. What is considered new and is desired to have protected by Letters Patent will be specifically stated in the appended claims.

What is claimed is:

1. In a telephone system, two offices, two register senders in one of the offices, and means for utilizing both said register senders to control the establishment of a single connection between a calling line in one office and a called line in either office.

2. In a telephone system, an office director comprising registering and sending mechanism, a line director common to said office director and other similar office directors, said line director also comprising registering and sending mechanism, automatic switches controlled by the office director to trunk a calling line to the office containing the called line, and other automatic switches controlled by the line director to complete the connection.

3. In a telephone system, office directors, line directors, means responsive to a call for connecting the calling line to an idle office director, and means responsive to the first registering operation in the selected office director for testing said line directors and for selecting an idle line director.

4. In a telephone system, a calling line, two classes of called lines, automatic switches for extending the calling line to a called line of either class, a single register sender adapted to control all the switches involved in a connection to a line in one class, and a second register sender for cooperating with the first register sender to control the switches involved in a connection to a line in the other class.

5. In a multi-office telephone system, switches for extending a calling line in one office to a second office, other switches for connecting the extended calling line to a called line, and two separate register senders in the first office for controlling the two series of switches, respectively.

6. In a telephone system, a trunk line, office directors for registering one part of called numbers, line directors for registering another part of called numbers, and separate means for associating an idle office director and an idle line director, respectively with said trunk line.

7. In a telephone system, an office director comprising a register, a translater, and a sender, a line director comprising a register and a sender, and means for utilizing both said directors to control the establishment of

a connection between a calling subscriber's station and a called subscriber's station.

8. In a telephone system, an office director comprising a register, a translater, and a sender, a line director comprising a register and a sender, means for utilizing both said directors to control the establishment of a connection between a calling subscriber's station and a called subscriber's station, and for utilizing only the office director to control the establishment of a connection between a calling subscriber's station and an operator's position.

9. In a telephone system, an office director, a line director, means for registering two successive parts of a called number on said office director and said line director, respectively, a sender in each director, and means responsive to the completion of the sending operation of said office director for starting the sending operation of said line director.

10. In a telephone system, a calling line, an office director, a line director, means for successively associating said directors with said line to register two successive parts of a called number on said directors, respectively, means responsive to the completion of the sending operation of said office director for starting the sending operation of said line director and for releasing said office director.

11. In a telephone system, a trunk, a first register for registering one part of a subscriber's number, a second register for registering another part of said subscriber's number, means individual to said trunk for associating said first register with said trunk, and additional means individual to said trunk for associating said second register with said trunk.

12. In a telephone system, a trunk, a first register for registering one part of a subscriber's number, a second register for registering another part of said subscriber's number, means for associating said first register with said trunk line operable responsive to the initiation of a call over said trunk line, means for associating said second register with said trunk line, and means in said first register for controlling the operation of said last means.

13. In a telephone system, a trunk line, a first director, a second director, means operable responsive to the initiation of a call over said trunk line for associating said first director with said trunk line, means for sending digits of a called number to said first director, and means operable after a digit has been sent for associating said second director with said trunk line.

14. In a telephone system, a trunk line, a first director, a second director, means operable responsive to the initiation of a call over said trunk line for associating said first director with said trunk line, means for sending digits of a called number to said first director, means operable after a digit has been sent for associating said second director with said trunk line, and means operable after a predetermined number of digits have been sent to said first director for causing the remaining digits of the called number to be sent to said second director.

15. In a telephone system, a trunk line, a first director, a second director, means operable responsive to the initiation of a call over said trunk line for associating said first director with said trunk line, means for sending digits of a called number to said first director, and means operable after a digit has been sent for associating said second director with said trunk line, and means operable after a predetermined number of digits have been sent to said first director for causing the remaining digits of the called number to be sent to said second director, providing the called number contains more digits than said predetermined number of digits, and means operable after said predetermined number of digits have been sent to said first director for effecting the disassociation of said second director from said trunk line providing the called number contains no more digits than said predetermined number.

16. In a telephone system, two directors, means responsive to the initiation of a call for seizing one of said directors, and means responsive to an actuation of the calling subscriber's calling device but independent of the value of the digit called for seizing the second of said directors.

17. In a telephone system, two directors, means responsive to the initiation of a call for seizing one of said directors, and means responsive to an actuation of the calling subscriber's calling device for seizing the second of said directors, and means responsive to another actuation of said calling device for releasing the second director.

18. In a telephone system, two directors, a calling line, means for successively associating said directors with said calling line, means for marking each director busy responsive to its association with said calling line, and means for registering one part of the called number only on one director and another part of the called number only on the other director.

19. In a telephone system, two groups of directors, a calling line, two hunting switches for successively associating an idle director of each group with said calling line, and means for registering one part of the called number on one of the directors and another part of the called number on the other of the directors.

20. In a telephone system, a first director, a second director, means responsive to the initiation of a call for seizing said first director, means for sending digits of a called number to said first director to be registered

thereon, means operable after one digit is sent for seizing said second director, and means operable after a predetermined number of digits have been sent to said first director for causing the remaining digits of the called number to be sent to said second director and for causing said first director to transmit digits to extend the call.

21. In a telephone system, a first director, a second director, means responsive to the initiation of a call for seizing said first director, means for sending digits of a called number to said first director to be registered thereon, means operable after one digit is sent for seizing said second director, means operable after a predetermined number of digits have been sent to said first director for causing the remaining digits of the called number to be sent to said second director and for causing said first director to transmit digits to extend the call, and means responsive to the completion of the transmitting operation of said first director for releasing the same.

22. In a telephone system, a first director, a second director, means responsive to the initiation of a call for seizing said first director, means for sending digits of a called number to said first director to be registered thereon, means operable after one digit is sent for seizing said second director, and means operable after a predetermined number of digits have been sent to said first director for causing the remaining digits of the called number to be sent to said second director and for causing said first director to transmit digits to extend the call, and means responsive to the completion of the transmitting operation of said first director for releasing the same and for conditioning said second director to transmit digits to complete the call.

23. In a telephone system, a trunk line comprising an incoming and an outgoing section, a first register sender, a second register sender, means operable responsive to the initiation of a call over said trunk line for associating said first register sender with said trunk line, means for sending digits of a called number to said first register sender, means operable after a digit has been sent for associating said second register sender with said trunk line, means operable after a predetermined number of digits have been sent to said first register sender for causing the remaining digits of the called number to be sent to said second register sender, means in said first register sender for sending the same or other digits over said outgoing section of said trunk line, and means responsive to the completion of its sending operation for disassociating said first register sender from said trunk line.

24. In a telephone system, a director for registering the office designation of a called number and for transmitting the office code, a register sender for registering the line designating digits of a called number and for retransmitting them, a sequence switch in said director having successive positions for controlling the transmitting of the digits of the office code, said switch being advanced to the next succeeding position after the completion of the transmission of each digit of the code, and means controlled by said switch in the position next to the position in which the last office code digit is transmitted, regardless of the number of digits in the code, for initiating the retransmission of the line designating digits.

25. In a telephone system, a director, a calling line, means for associating said director with said line, means in said director for registering the office designations of called numbers and for transmitting office codes, comprising a variable number of digits, a sequence switch having successive positions for controlling the transmitting of the digits of the office codes, said switch being stepped into the next succeeding position after the completion of the transmission of each digit of an office code, and means controlled by said switch in the position next to the position in which the last digit of an office code is transmitted, regardless of the number of digits in the code, for initiating the disassociation of said director from said line.

26. In a telephone system, a calling line, two register senders, each adapted to be controlled over said line separately, a called line, and means for utilizing both said register senders to control the establishment of a connection between said calling line and said called line.

27. In a telephone system, two register senders, a trunk line, and means for causing both said register senders to send impulses over said trunk line to control the establishment of a connection via said trunk line.

28. In a telephone system, a trunk line, two register senders, means for successively causing said register senders to transmit impulses over said trunk line to control the establishment of a connection.

29. In a telephone system, two register senders for registering two different parts of a called number, respectively, a trunk line having a branch at one end, and means for successively associated said register senders with said branch to cause them to control the establishment of a connection via said trunk line.

30. In a telephone system, a trunk line, two independent register senders, means responsive to a call for connecting said register senders directly to said trunk line at adjacent points between the two ends thereof, and means for causing said register senders to control the extension of said trunk line to complete the call.

31. In a telephone system, an office director,

a line director, automatic switches controlled by the office director independent of the line director to trunk a calling line to the office containing the called line, and other automatic switches controlled by the line director independent of the office director to complete the connection.

32. In a telephone system, a trunk line, a first register sender, a second register sender, means for associating said register senders with said trunk line, means for operating the first register sender to control the establishment of a certain class of connections, and for operating both of said register senders, each controlled over said trunk line separately, to control the establishment of a different class of connections.

33. In a telephone system, a trunk line, a first register sender, a second register sender, means for associating said register senders with said trunk line, means for operating the first register sender to control the establishment of a certain class of connections, and for operating both of said register senders, each controlled over said trunk line separately, to control the establishment of a different class of connections, and means for disassociating the second register sender from said trunk line during the operation of the first register sender in controlling the establishment of a connection of said certain class.

34. In a telephone system, a first and a second digit register, means for variably operating said registers to register digits, means for seizing the first register, means responsive to a partial operation of the first register for seizing the second, and means responsive to a complete operation of the first register to a particular position for releasing the second register.

35. In a telephone system, two digit registers, means for seizing the first register, means responsive to the registration of a digit in the first register for seizing the second register, and means responsive to the registration of another digit, providing the two digits compose a particular number, for releasing the second register.

36. In a telephone system, a first and a second digit register, means for seizing the first register and for providing an impulsing path thereto over which digits may be sent, means responsive to the registration of a digit on said first register for seizing said second register, and means responsive to the registration of another digit on said first register for providing an impulsing path to the second register.

37. In a telephone system, a first and a second digit register, means for seizing the first register and for providing an impulsing path thereto over which digits may be sent, means responsive to the registration of a digit on said first register for seizing said second register, means responsive to the registration of another digit on said first register for providing an impulsing path to the second register, and means responsive to the registration of the other digit whenever the two digits registered composed a particular number for releasing said second register.

38. In an automatic telephone system, a register sender containing registering apparatus operable to register a portion of a telephone number, sending apparatus in said register sender operable under the control of the registering apparatus, a second register sender containing registering apparatus effective to register a further portion of the same telephone number, and sending apparatus in the second register sender operable under the control of the associated registering apparatus.

39. In a telephone system, two register senders, registering apparatus in the first register sender operable to register a portion of a telephone number, registering apparatus in the second register sender and means for operating it to register an additional portion of the same telephone number, sending apparatus in the first register sender and means for operating it under the control of the associated registering apparatus while the registering apparatus in the second register sender is being operated, and sending apparatus in the second register sender and means for operating it subsequently under the control of the associated registering apparatus in the second register sender.

40. In an automatic telephone system, a train of automatic switches arranged to be operated to set up a telephone connection from a calling line to a called line, two switch controllers, means in the first switch controller for registering a portion of the digits of the telephone number of a called line and for operating a portion of said train of switches in accordance therewith, and means in the second switch controller for registering the remaining digits in the number of the called telephone line and for operating the remaining switches in the train to complete the connection to the called telephone line.

41. In an automatic telephone system, a first register sender and a second register sender, means controlled over a calling telephone line for operating registering apparatus in the first register sender to register a portion of the digits in a called telephone number, means in the first register sender for retransmitting digits in accordance with the digits registered therein, means in the second register sender controlled from the calling line over a circuit path excluding the first register sender to register additional digits in the same called telephone number, and means in the second register sender for retransmitting digit impulses in accordance with the digits registered therein.

42. In an automatic telephone system, a trunk line, a first register sender and a second register sender, means for taking said trunk line for the exclusive use of a calling line, means controlled over said calling line and said trunk line for setting up digits in the first register sender, means in the first register sender for retransmitting digit impulses in accordance with the digits set up therein, means subsequently controlled from said calling line and over said trunk line while it is still retained for the exclusive use of said calling line for setting up additional digits in the second register sender, means in the second register sender for retransmitting digit impulses in accordance with the digits set up therein, and means effective thereafter for returning said trunk line to common use.

43. In an automatic telephone system, two register senders, each register sender being arranged to register and retransmit digit impulses, and means for operating the second register sender to register and retransmit digit impulses after the first register sender has finished its operation, and a train of automatic switches operated successively responsive to the digit impulses sent out by both register senders.

44. In a telephone system, a trunk line, a register sender operable over a calling line to register digits of a telephone number, said register sender being operable in accordance with the registered digits to retransmit digit impulses to automatic switching apparatus by way of said trunk line, means for operating the second register sender to register additional digits, and sending apparatus in the second register sender operable under the control of the associated registering means to retransmit additional digit impulses over the same trunk line to the automatic switching apparatus.

45. In a telephone system, a trunk line having two branches each terminating in a hunting switch, a group of register senders accessible to the first hunting switch, and a group of register senders accessible to the second hunting switch.

46. In a telephone system, a trunk line having two branches, two groups of register senders corresponding to said two branches respectively, hunting apparatus arranged to connect any register sender in the first group to the first of said branches, and hunting apparatus arranged to connect any register sender in the second group to the second of said branches.

47. In a telephone system, a trunk line, register senders, means for connecting two of said register senders to said trunk line at the same time, a switching relay in said trunk line arranged to initiate the disconnection of said register senders from the trunk line, and means for operating said switching relay from either of said register senders.

48. In a telephone system, a trunk line, register senders, means for setting up a branch connection from said trunk line to one of said register senders and for setting up an additional branch connection from said trunk line to another of said register senders, a line relay in said trunk line, and means for operating said line relay to send impulses to both of said register senders.

49. In a telephone system, a trunk line, register senders, means for setting up a branch connection from said trunk line to one of said register senders and for setting up an additional branch connection from said trunk line to another of said register senders, a line relay in said trunk line, means for operating said line relay to send impulses to the first of the connected register senders, and means for subsequently operating the line relay to send impulses to the second of said register senders.

50. In a telephone system wherein automatic switches are employed to set up connections between calling and called lines, a group of trunk lines over which said connections are set up, a group of register controllers common to said trunk lines, means for taking one of said trunk lines for use and for transmitting digits thereover to effect the setting up of a connection, and means depending upon the value of the number represented by such digits for determining whether one of said register controllers is to be connected with the trunk line or not.

In witness whereof, I hereunto subscribe my name this 8th day of November, A. D. 1926.

RODNEY G. RICHARDSON.