

Nov. 3, 1942.

A. J. BUSCH

2,301,015

TELEPHONE SYSTEM

Filed March 22, 1940

6 Sheets-Sheet 1

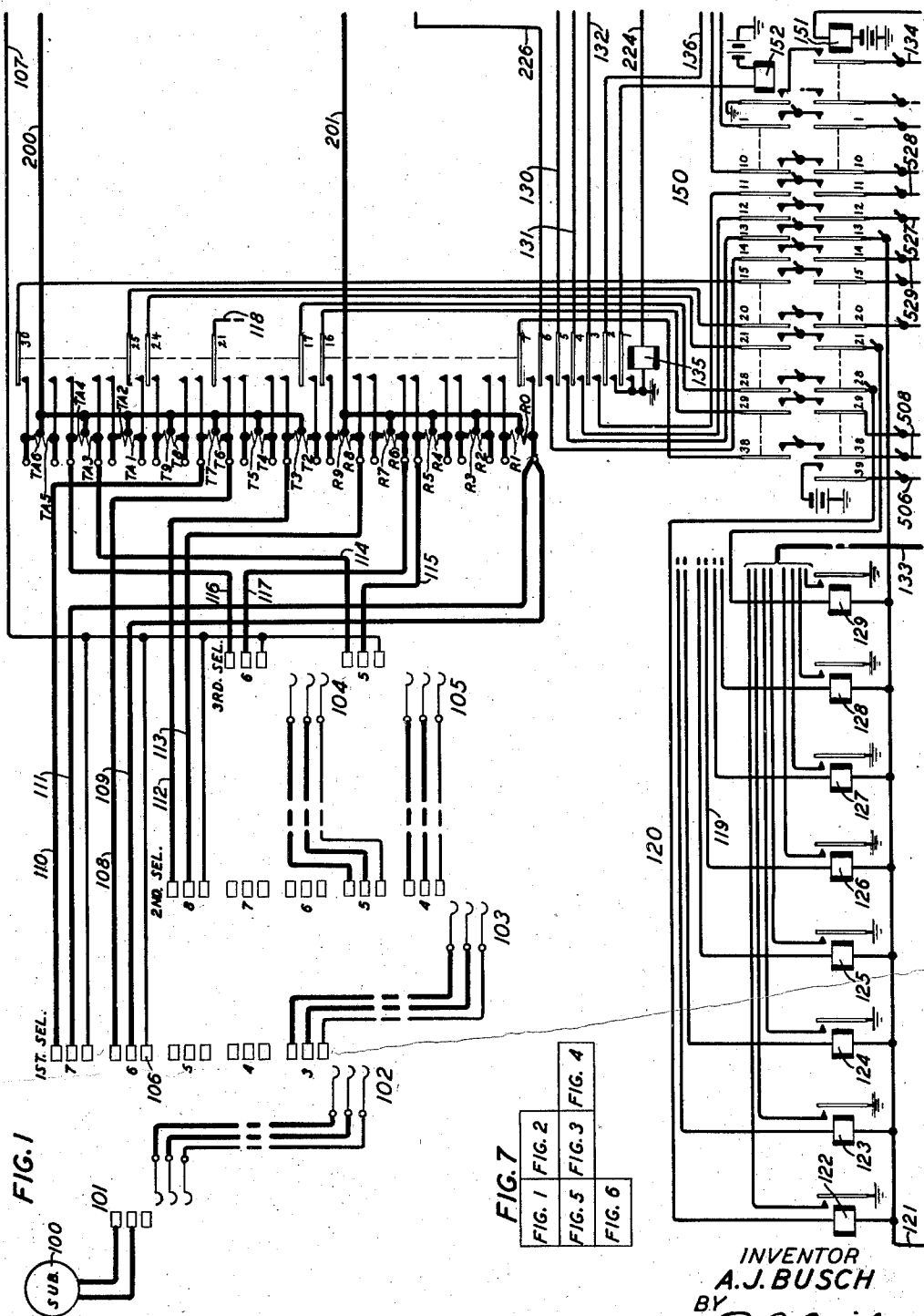


FIG. 7

FIG. 1 FIG. 2

FIG. 5	FIG. 3	FIG. 4
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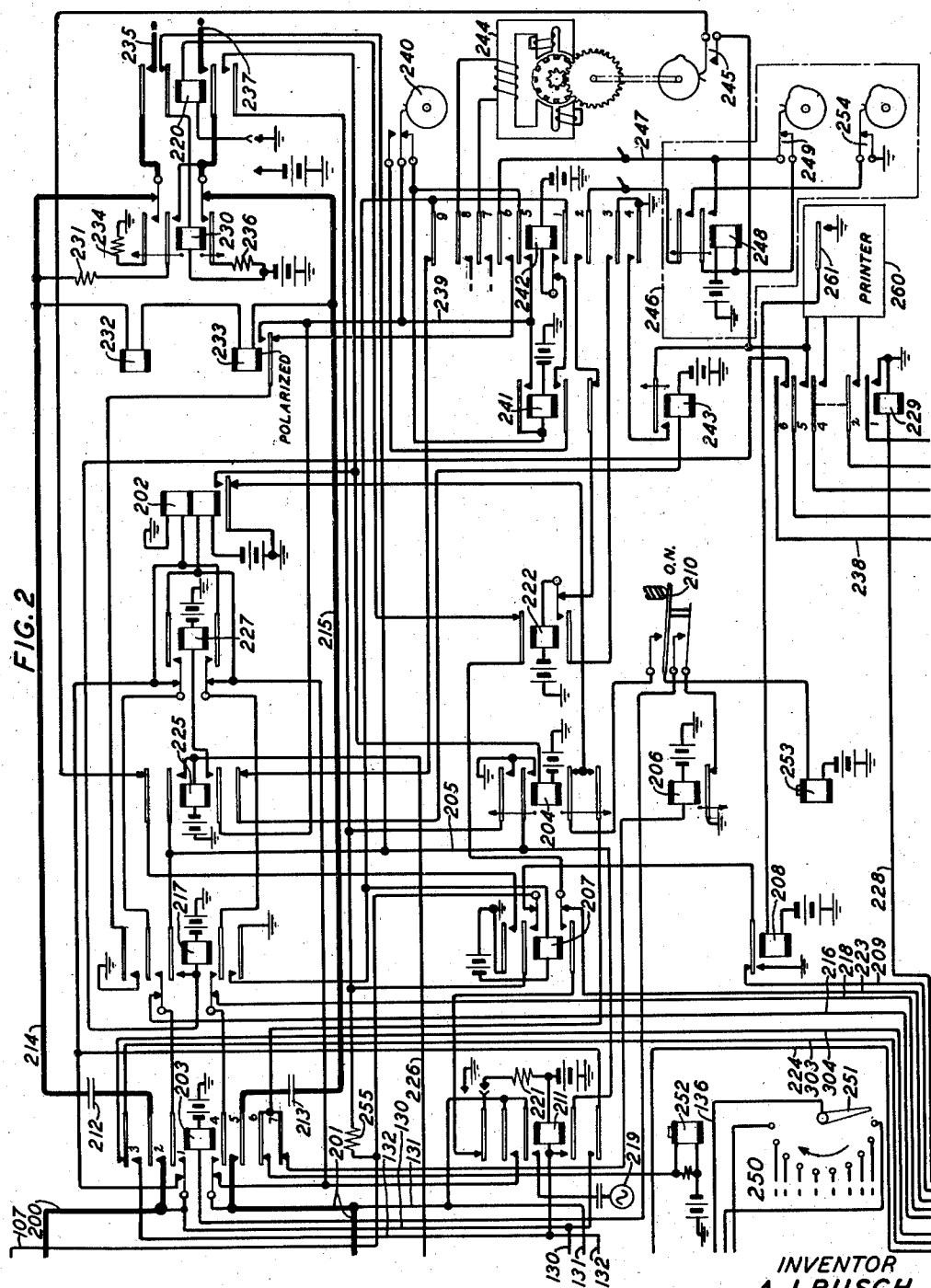
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6 Sheets-Sheet 2



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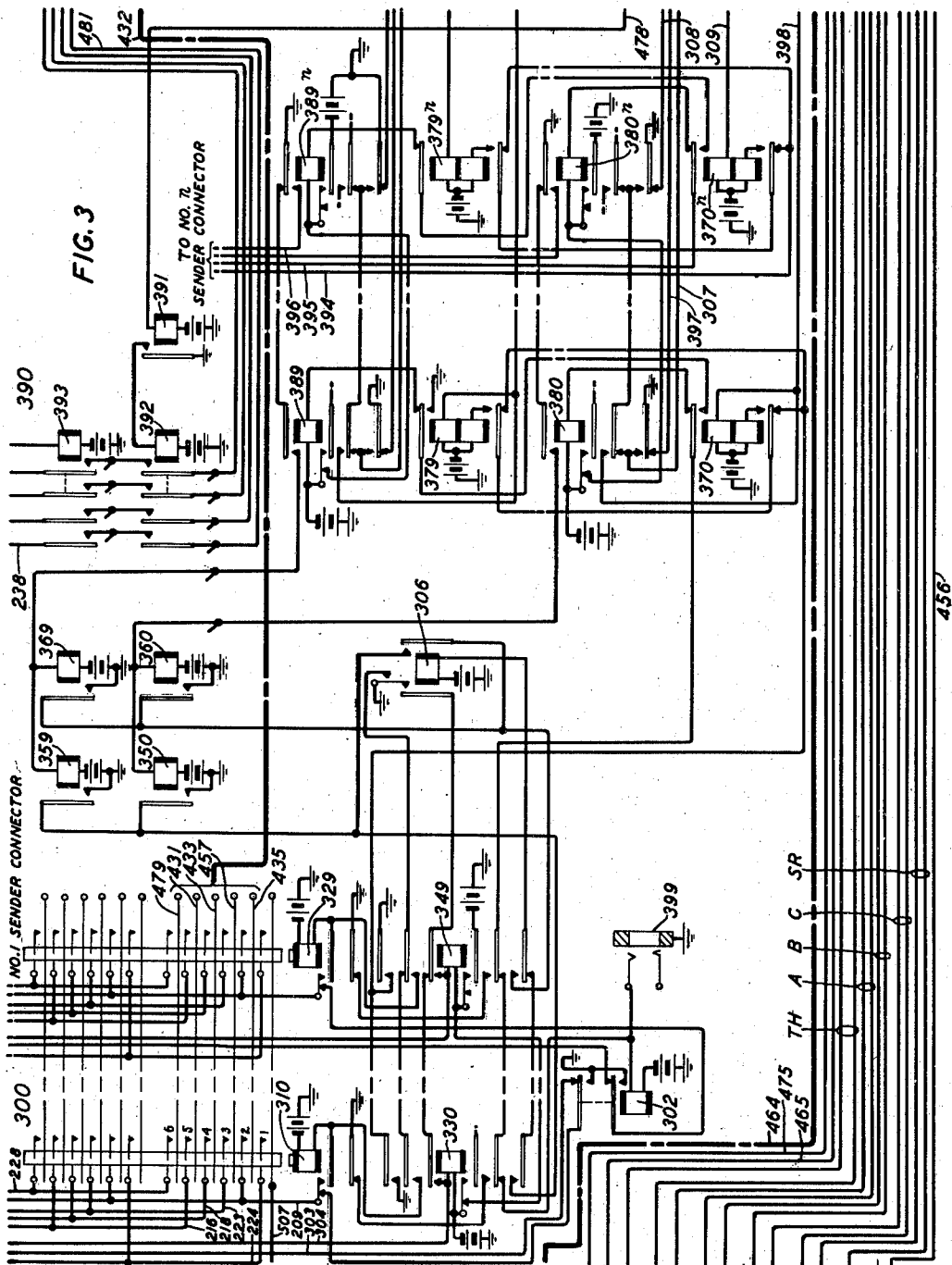
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TELEPHONE SYSTEM

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6 Sheets--Sheet 3



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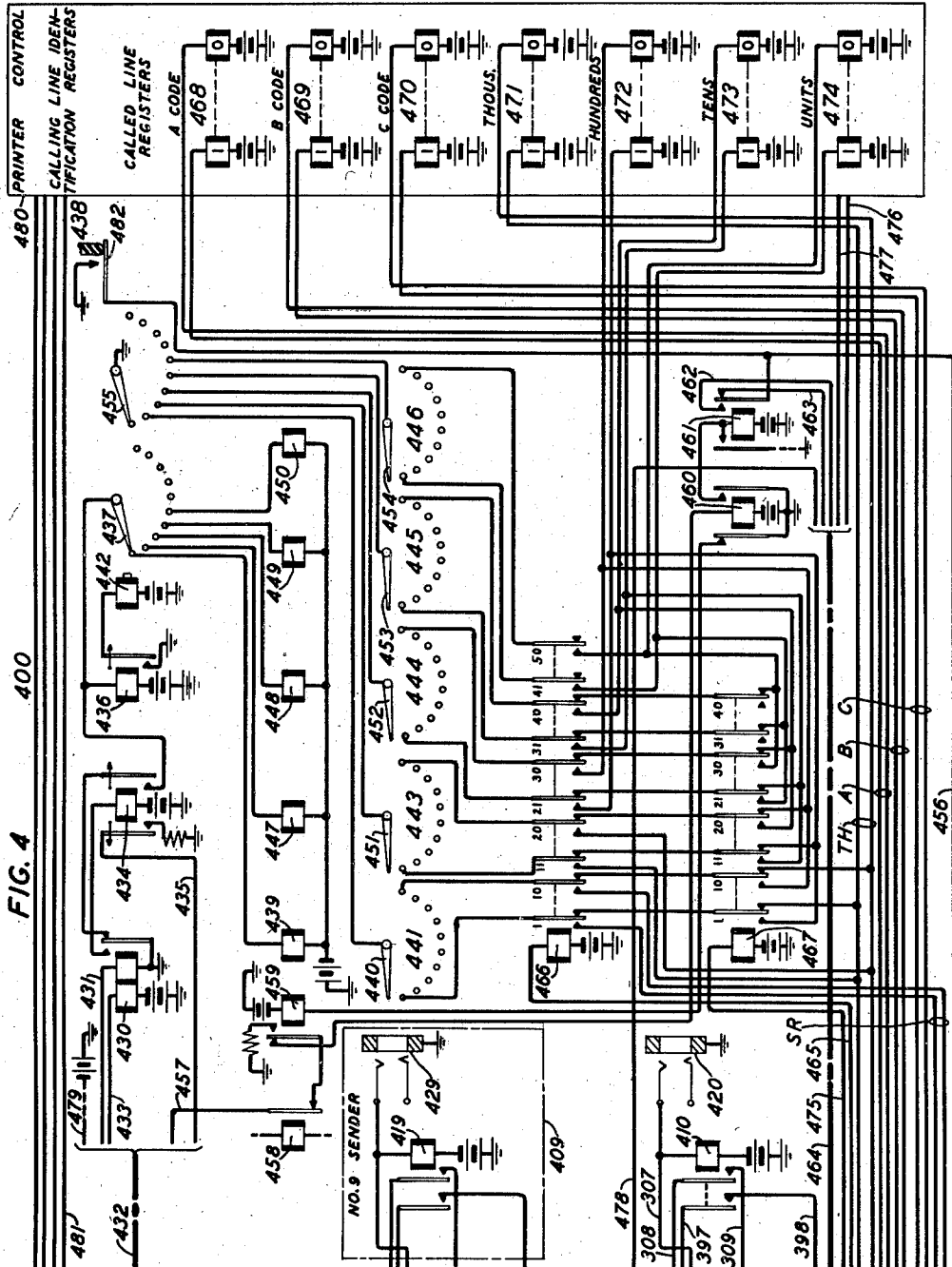
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TELEPHONE SYSTEM

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6 Sheets-Sheet 4



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TELEPHONE SYSTEM

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6 Sheets-Sheet 5

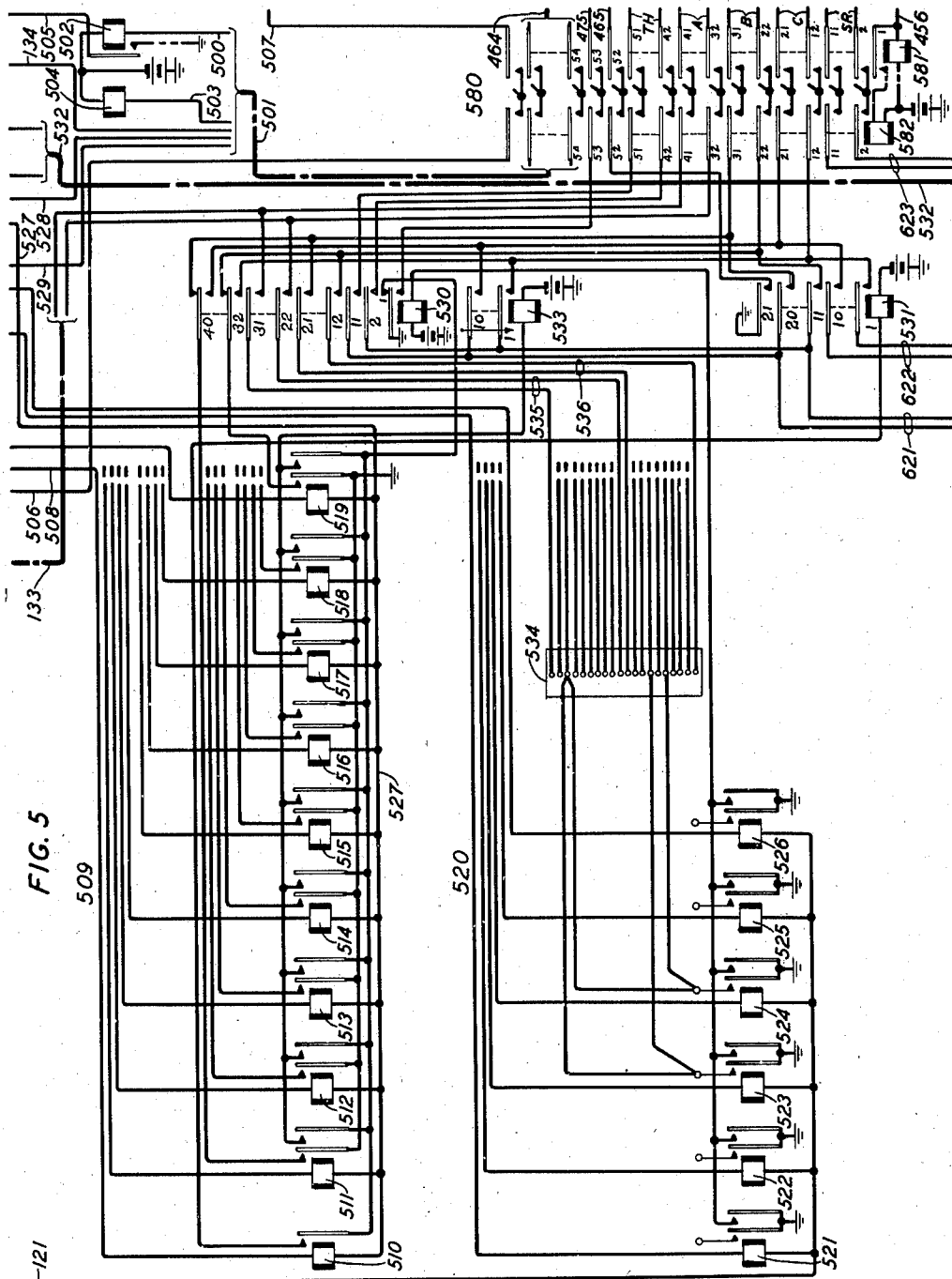


FIG. 5

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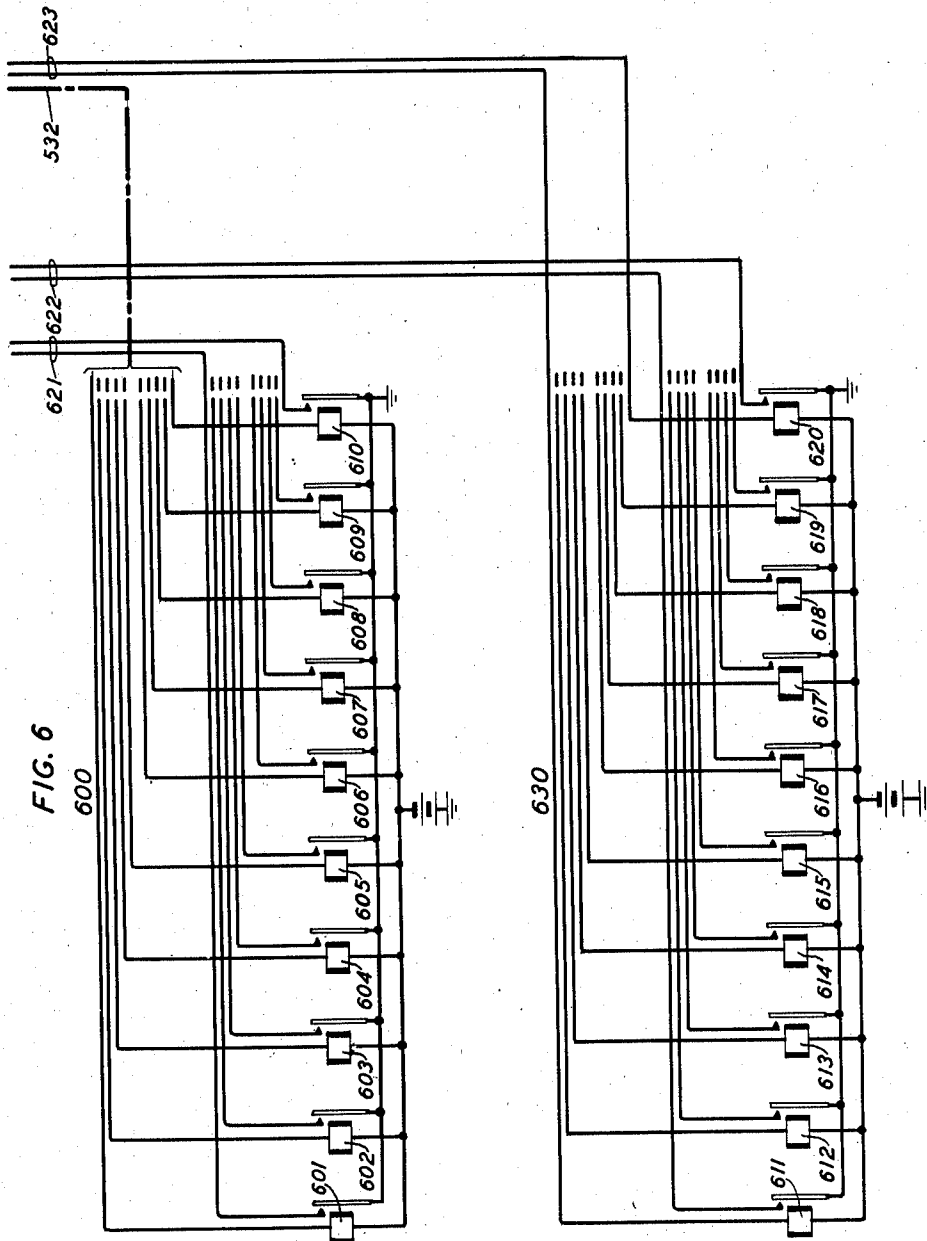
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TELEPHONE SYSTEM

Filed March 22, 1940

6 Sheets-Sheet 6



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UNITED STATES PATENT OFFICE

2,301,015

TELEPHONE SYSTEM

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Application March 22, 1940, Serial No. 325,304

22 Claims. (Cl. 179—7.1)

This invention relates to a telephone system and more particularly to a system in which connections are established to certain offices over a tandem trunk by selecting the trunk in response to the dialing of one or more of the office code digits of the wanted office designation and in which it is necessary to secure a record of the office code digits dialed for controlling the further extension of a connection from the trunk to the desired office or for other purposes.

In telephone systems of the type in which selector switches are controlled by a register sender common to all lines of an originating office in which both the office code digits and numerical digits of wanted lines are registered in response to dialing by a calling subscriber, it is the well-known practice when the wanted line terminates in a distant office to provide intermediate or tandem offices through which such calls are extended to such distant offices. Such a tandem office is provided with trunks incoming from originating offices which terminate in selector switches having access to trunks outgoing to such distant offices and with tandem senders accessible from the tandem trunks which are capable of controlling selector switches to extend a connection from a tandem trunk to a desired distant office and for setting selector switches in the selected distant office to terminate the connection. The tandem trunk is selected by the setting of selector switches in response to the registration of the office code digits of a wanted line which terminates in the distant office whereupon the tandem trunk seizes an idle tandem sender and the originating sender transfers all of its digit registrations including the office code and numerical digit registrations of the wanted line number to registers of the tandem sender. The tandem sender then proceeds to control selector switches to extend a connection from the tandem trunk to the office of the wanted line in accordance with the office code digit registrations transferred thereto from the originating sender and to control selector switches in the selected office in accordance with numerical digit registrations transferred thereto from the originating sender.

When, however, it becomes desirable to provide tandem office equipment of the type above described in telephone systems which have no common senders in the originating offices and in which the selector switches are of the type which are controlled in their selective movements directly under the control of a calling subscriber's dial, it becomes necessary when a tandem trunk is selected by the setting of such selector switches

in response to the dialing of the office code digits of a wanted line terminating in a distant office to be reached through the tandem office to provide means at the tandem office for ascertaining the office code digits which have been dialed so that the tandem sender may register such digits for use in further extending the connection from the tandem trunk to such wanted office.

A specific application of tandem trunking of this character may be made for example in connection with the extension of short haul toll connections to offices in the nearby toll area in which the tandem trunks are provided with automatic toll ticketing facilities whereby all such short haul toll connections may be established automatically under the control of a calling subscriber's dial and the toll ticket may be automatically printed. A system of this type is disclosed in the copending application of J. W. Gooderham, Serial No. 325,342, filed concurrently herewith. Since for ticketing purposes the ticket printer must be supplied with the designations of both the calling and wanted lines, it is further essential that the office code digits of the wanted line dialed by a calling subscriber to select the tandem trunk be made available for the use of the toll ticket printer.

It is therefore the object of the present invention to provide facilities at a tandem trunk which may in a simple and accurate manner ascertain any office code digits which a calling subscriber may have dialed in setting up a connection to the tandem trunk and which may make a record of any office code digits dialed subsequent to the establishment of a connection to the tandem trunk.

As illustrated herein the subscriber desiring a connection to a line terminating in an office of a nearby toll area first removes his receiver from the switchhook whereby an idle line finder, paired with a first selector, is started in search of the calling line and as soon as the line is found the usual dial tone is transmitted. Upon hearing the dial tone the subscriber then proceeds to dial the office code and numerical digits of the wanted line number. In response to the dialing of one or more of the office code digits, the selector switches of a switching train including the first selector switch are operated to extend a connection from the calling line to an idle tandem or automatic ticketing trunk accessible from all lines of the office in which the calling line terminates over which trunk a connection may be further extended to the office in which the wanted line terminates.

Immediately following the seizure of the trunk an idle sender common to a plurality of such trunks is associated with the seized trunk over a sender-connector switch. The sender is provided with registers for registering the remaining digits of the called line number dialed by a calling subscriber. Since, however, a digit dialed by a calling subscriber might be lost during the time elapsing between the seizure of the trunk and the seizure of an idle sender, the trunk is provided with a digit register for registering the digit dialed following the last code digit dialed to reach the trunk. On calls to certain offices the trunk may be seized by a first selector in response to the dialing of a first office code digit. On calls to other offices, the trunk may be seized by a second selector in response to the dialing of two office code digits while on calls to still other offices, the trunk may be seized by a third selector in response to the dialing of three office code digits. Since the trunk may be seized in response to the dialing of one, two or three code digits, the trunk register may register either the second or third code digits or the thousands numerical digit. As soon as the first digit has been registered in the sender which digit may be either the third code digit, the thousands digit or the hundreds digit, an idle decoder is associated with the sender over a decoder-connector and the decoder is associated directly with the trunk over a trunk decoder-connector. Thereupon office code identifying equipment associated with the trunk transfers to registers in the decoder information concerning the office code digits dialed to reach the trunk and if office code digits have been registered by the trunk register or by the first register of the sender, such registration or registrations are also transferred to the decoder whereby the decoder thus receives all of the information necessary regarding the office designation of the desired line. This information may be translated by the decoder if necessary and the registered information or the translated information is then transferred to control registers of the sender which are instrumental in controlling selector switches to extend the connection from the trunk to the office in which the wanted line terminates and in controlling the ticket printer of the trunk to print the called office code digits on a toll ticket. If the thousands numerical digit has been registered by the trunk register and such registration has been transferred to the decoder, this registration is also transferred to the sender from the decoder. The sender also registers the remaining numerical digits dialed by the calling subscriber and in accordance with its numerical digit registration directs the setting of selector switches in the called office, such numerical digit registrations also being effective to control the printer to print such numerical digits on the toll ticket. For controlling the ticket printer in accordance with the code and numerical digit registrations made in the sender, the sender becomes associated with the trunk over a trunk sender-connector.

The sender may also receive digit registrations from calling line identifying equipment associated with the decoder of the type fully disclosed in the application of J. W. Gooderham hereinbefore referred to and control the ticket printer of the trunk to print such identification digits on the toll ticket. The ticket printer may also be controlled following the response of the called subscriber and during the continuance of the conversation to print information on the toll

ticket indicative of the duration of the conversational period.

The invention having been described in a general manner, reference may now be had to the following detailed description thereof taken in connection with the accompanying drawings in which:

Fig. 1 shows schematically a calling line, a line finder and a train of first, second and third selector switches for extending a connection from the calling line to a tandem automatic ticketing trunk, branches of the incoming ends of the tandem trunk of Fig. 2, the schematic disclosure of a trunk decoder-connector and one of the office code digit registers of a decoder;

Fig. 2 shows the remaining portion of the tandem trunk including a step-by-step type digit register, a timing mechanism of the electric clock motor driven type and a toll ticket printer schematically illustrated by the box in the lower right portion of the figure;

Fig. 3 shows in the upper right portion thereof a trunk sender-connector and in the remaining portion thereof a sender-connector and the control circuits therefor whereby an idle sender is associated with a calling tandem trunk;

Fig. 4 shows such portions of a sender as are necessary to an understanding of the invention;

Fig. 5 shows additional registers and relays of a decoder;

Fig. 6 shows other registers of a decoder; and,

Fig. 7 is a diagram showing how the other figures of the drawing should be arranged to completely disclose the invention.

The line finder 101 and the selector switches 102, 103, 104 and 105 may be of the well-known step-by-step type and the selector switches may be controlled directly by a calling subscriber's dial to establish local connections or to establish a connection to an idle automatic ticketing trunk such as is disclosed in Figs. 1 and 2 should the subscriber desire a connection to a subscriber's line which terminates in the toll area adjacent to the exchange area in which the calling line terminates. As disclosed the automatic ticketing trunk of Figs. 1 and 2 has branches which terminate in banks of first selectors such as 102, other branches which terminate in banks of second selectors such as 103 and still other branches which terminate in banks of third selectors such as 104 and 105 whereby the trunk may be seized in response to the dialing of the first office code digit of certain distant offices, in response to the dialing of the first and second office code digits of other offices and in response to the dialing of the three office code digits of still other offices. With the arrangement illustrated to simplify the disclosure, but one group of tandem trunks would be available for serving connections to all offices in the toll area. In the commercial use of the invention, however, a plurality of groups of tandem trunks would be required to handle the toll traffic and therefore some of the groups of trunks would be made accessible only from bank levels of first selectors, other groups would be made accessible only from bank levels of second selectors and still other groups would be made accessible from bank levels of third selectors. Still other groups might have incoming branches as disclosed accessible from bank levels of different selectors. The trunking scheme may therefore be made quite flexible for allocating the trunk groups in accordance with the density of the toll traffic to different portions of the toll area.

The register switch 250 associated with the

tandem trunk of Fig. 2 may be of the rotary step-by-step type, the brush 251 of which is advanced step by step in response to the operation of its stepping magnet 252 and is restored to normal by the operation of its release magnet 253. The ticket printer 260 indicated by the box may be of any well-known type as for example a teletypewriter in which the type bars are selected for operation by a plurality of magnet operated comb bars. The timer 244 for timing the duration of the conversational period is of the electric clock motor driven type.

The cross-bar sender-connector 300 of Fig. 3 may be of the general type disclosed in Patent 2,021,329 granted November 19, 1935 to J. N. Reynolds. Since the sender-connector does not have sufficient cross-point contacts to accommodate all of the control conductors required between a trunk and a sender, an additional trunk sender-connector switch 390 is provided. This latter switch, the trunk decoder-connector 150 of Fig. 1 and the decoder-connector 580 of Fig. 5 are of the multicontact relay type such as are employed in the cross-bar system and as are disclosed, for example, in Patent 2,089,921 granted August 10, 1937 to W. W. Carpenter.

The sender, portions of which are disclosed schematically in Fig. 4, may be of a well-known type provided with incoming registers for registering the digits of a wanted line number dialed by a calling subscriber and with pulsing mechanism for controlling the setting of step-by-step selector switches in accordance with such registrations to extend a connection from the seized ticketing trunk to a wanted line. In addition the sender is provided with a printer control circuit 480 for controlling the ticket printer of the trunk with which the sender has become associated, which control circuit has relay registers for registering all of the digits of a wanted line number and the identifying digits of the calling line number. The relay registers for registering the called office code digits are controlled from the settings of the office code digit registers of an associated decoder and the relay registers for registering the numerical digits of the called line may be set in accordance with the setting of the incoming registers of the sender or by such incoming registers in conjunction with a register of the decoder. The called office digit registers of the control circuit are also used by the sender in controlling the setting of selector switches to terminate the connection. For assisting a sender in controlling the establishment of a desired connection, a plurality of decoders is provided, such portions of one of such decoders as are necessary to an understanding of the invention being disclosed in Figs. 1, 5 and 6. The decoder is associateable with a sender over the decoder-connector 580 and with the trunk over trunk decoder-connector 150.

To more clearly set forth the novel features of the invention, it will be assumed that the calling subscriber whose substation is indicated by the numeral 100 initiates a call for a toll connection to a subscriber's line terminating in an office of the toll area to which the calling subscriber is permitted access by dialing. Upon the removal of the receiver from the switchhook, an idle line finder having access to the calling line, such as line finder 101, is started in search of the calling line in a well-known manner. When the line finder has found the calling line, the usual dial tone is transmitted over the calling line to inform the subscriber that his line has been connected

with a first selector 102, paired with the line finder 101, and that he may therefore commence dialing the digits of the wanted line number.

It will first be assumed that the calling subscriber desires a connection with a line whose directory number is MAR-1000 and that a tandem ticketing trunk over which a connection to this office may be extended may be reached from the sixth bank level of the first selector 102. The calling subscriber upon hearing the dial tone therefore proceeds to dial the office code letters MAR and the numerical digits 1, 0, 0, 0. In response to the dialing of the first office code letter M, which has a numerical equivalent 6, the first selector 102 is operated to elevate its brushes to a position opposite the sixth bank level and to then hunt over the terminals of this level in search of an idle tandem trunk. It will be assumed that the trunk disclosed in Figs. 1 and 2 is idle and that therefore when the test brush of the selector 102 engages the test terminal 106 of this trunk, it will encounter no busy ground potential thereon and that therefore the selector switch will seize the trunk and extend a connection from the calling line to the tip and ring conductors 200 and 201 of the trunk. A circuit is thereupon established from ground through the upper winding of relay 202, the No. 1 normal contacts of relay 203, tip conductor 200, through resistance T6 of approximately 10 ohms, branch conductor 108, tip brushes of selector 102 and line finder 101 over the calling line loop through substation 100, thence returning over the ring brushes of line finder 101 and selector 102, branch conductor 109 through resistance R0 over conductor 201, the No. 4 normal contacts of relay 203 to battery through the lower winding of relay 202. Relay 202 thereupon operates closing over its front contact an obvious circuit for slow-to-release relay 204 which operates; connects ground over its upper contacts through the inductive resistance 255 and over sleeve conductor 107 of the trunk to the test terminals of all appearances of the trunk in the banks of selector switches for marking the trunk as busy to other selector switches having access thereto; connects ground to conductor 205 over its inner upper front contacts for furnishing locking ground for other relays of the trunk; at its lower front contact prepares operating circuits for relay 206 and stepping magnet 252 of the digit register 250 and at its upper front contacts establishes a circuit for initiating the association of an idle sender with the trunk. This latter circuit may be traced from ground over the upper front contacts of relay 204, resistance 255, the inner upper normal contacts of relay 207, back contact of relay 208, conductor 209, inner normal contacts of hold magnet 310 of one of the two cross-bar switches constituting the sender-connector 300, a back contact of make-busy relay 302, conductor 303, the No. 3 back contact of relay 293 and conductor 304 through the winding of line relay 330, individual to the trunk of Fig. 2 whereupon relay 230 operates.

A plurality of sender-connectors such as 300 is provided each serving two groups of ten trunks each and all having common access to ten senders. Each sender-connector comprises two cross-bar type switches each of which has one hundred sets of cross-point contacts arranged in ten vertical rows allocated to ten trunks and arranged in ten horizontal rows allocated to ten senders, any set of cross-point contacts being operable through the conjoint operation of one of the se-

lect magnets, such as 350, individual to an idle sender and one of the hold magnets, such as 310, individual to the calling trunk. The two cross-bar switches of a connector function as a unit and therefore their corresponding select magnets are multiplied together for simultaneous operation and their hold magnets and line relays are arranged in chain lock-out circuits whereby the line relay and hold magnet individual to but one trunk may be simultaneously operated and the trunks Nos. 0 to 19 are given a preference in the order named in the selection of an idle sender.

Common to all of the sender-connectors is a chain sender start and lock-out circuit provided with pairs of sender start and busy relays arranged coordinately, vertical rows of such pairs of relays being allocated to the several sender-connectors and horizontal rows of such pairs of relays being allocated to ten senders. For example, the sender busy relay 370 and the associated sender start relay 380, allocated to the No. 0 sender 400 disclosed in Fig. 4, the sender busy relay 379 and the associated sender start relay 389 allocated to the No. 9 sender 409 indicated by the dot-dash rectangle in Fig. 4 and intervening pairs of such relays (not disclosed) allocated to the Nos. 1 to 8 senders are allocated to the No. 1 sender-connector 300 and sender busy relay 370ⁿ and the associated sender start relay 380ⁿ allocated to the No. 0 sender 400, the sender busy relay 379ⁿ and the associated sender start relay 389ⁿ allocated to the No. 9 sender 409 and intervening pairs of such relays (not disclosed) allocated to the Nos. 1 to 8 senders are allocated to the No. *n* sender-connector (not shown). Intermediate rows of such relays are similarly allocated to intermediate sender-connectors. By means of the sender start and lock-out circuit, senders Nos. 0 to 9 are given preference for selection in the order named.

It will be recalled that line relay 330 was operated following the seizure of the trunk of Fig. 2. Relay 330 upon operating prepares over its lower front contact an operating circuit for relay 306; prepares over its inner upper front contact a locking circuit for itself; prepares over its middle upper front contact an operating circuit for hold magnet 310; disconnects at its inner lower normal contacts operating battery for the succeeding line relays individual to the remaining nineteen trunks served by the sender-connector 300 and, assuming that the No. 0 sender is available for use, closes a circuit from ground over the lower back contact of hold magnet 310, middle lower front contact of relay 330, thence over back contacts of succeeding line relays (not shown) including line relay 349 of the No. 19 trunk and the upper back contact of sender busy relay 370 to battery through the winding of sender start relay 380. Relay 380 thereupon operates, disconnects at its inner lower normal contacts operating battery for succeeding start relays such as 380ⁿ allocated to the No. 0 sender and to other sender-connectors to prevent the seizure of the No. 0 sender by trunks terminating in other sender-connectors; at its lower front contact establishes a circuit for sender make-busy relay 410 which may be traced from ground thereover and conductor 307 to battery through the winding of relay 410 and establishes a circuit extending from ground at the upper back contact of relay 380ⁿ, over the back contacts of intermediate relays and its own upper front contact through the windings of select magnets 350 and 360 in parallel of the cross-bar switches of the sender-con-

ductor 300 to battery, thereby operating said magnets. Sender make-busy relay 410 upon operating closes operating circuits for all sender make-busy relays in the group 370 to 370ⁿ allocated to the No. 0 sender with the exception of relay 370, the circuit of relay 370ⁿ, for example, being established from ground at the lower back contact of relay 380ⁿ, over conductor 308, the inner contact of relay 410 and conductor 309 to battery through the upper winding of relay 370ⁿ. The similar operating circuit for relay 370 is not closed over the outer contacts of relay 410 since it is now open at the lower back contact of relay 380. With sender make busy relays such as 370ⁿ now operated, no trunk served by the other sender-connectors is able to seize the busy No. 0 sender 400.

Should, for example, a trunk served by the No. *n* sender-connector attempt to seize a sender, the operation of the individual line relay of such trunk, corresponding to line relay 330, will establish a holding circuit for relay 370ⁿ from ground over its upper front contact, conductor 394, thence in parallel over the lower back contacts of other sender busy relays such as 379ⁿ and over the lower front contact and through the lower winding of relay 370ⁿ to battery to prevent the release of relay 370ⁿ should the No. 0 sender thereafter become idle. Such line relay will also establish a start circuit from ground over its middle lower front contact, the middle lower back contacts of succeeding line relays, conductor 395, upper front contact of relay 370ⁿ, thence in a chain circuit over the upper front contacts of sender busy relays of other busy senders and the upper back contact of the sender busy relay of the first idle sender in the order of preference, for example, relay 379ⁿ, to battery through the start relay of such sender, for example, relay 389ⁿ. In the manner previously described the make-busy relay of such sender, corresponding to relay 410, will be operated to perform the function previously described in connection with the operation of relay 410. If it be assumed that the sender start relay 389ⁿ and the sender make-busy relay 419 of the No. 9 sender 409 are operated, the operation of relay 389ⁿ will establish an operating circuit over conductor 396 for the select magnets of the No. *n* sender-connector individual to the No. 9 sender corresponding to magnets 359 and 369.

With line relay 330 and select magnets 350 and 360 operated as previously described, the circuit of relay 306 is completed from ground at the front contact of magnet 350 over the lower front contact of relay 330 and the back contacts of succeeding line relays including relay 349 to battery through the winding of relay 306. Relay 306 upon operating closes a locking circuit for the operated line relay 330 extending from battery through the winding and inner upper front contact of relay 330, thence over the inner upper back contacts of succeeding line relays including relay 349 to ground at its outer left contact; establishes an operating circuit for hold magnet 310, individual to the calling trunk of Fig. 2, which may be traced from battery through the winding of magnet 310, over the middle upper front contact of line relay 330 and the middle upper back contacts of succeeding line relays including line relay 349, to ground at its inner left contacts and at its right contacts connects ground from the front contact of operated select magnet 350 into its own operating circuit whereby it is held operated so long as either select magnet 350 or 360 remains

operated. Hold magnet 310 upon operating, with select magnet 350 operated, closes the lower left set of cross-point contacts; locks over its inner lower alternate contacts directly to ground on conductor 209; at its lower back contact opens the circuit over which start relay 380 was operated thereby releasing relay 380 and in turn releasing the select magnets 350 and 360 and at its lower alternate contacts opens the initial operating circuit of line relay 330. Select magnets 350 and 360 upon releasing in turn release relay 306 thereby opening the initial operating circuit of hold magnet 310 and the locking circuit of line relay 330. The selected cross-point contact set is now held operated by the continued energization of hold magnet 310 over its locking circuit. With line relay 330 released, operating battery is now supplied to the operating circuits of the other line relays of the sender-connector and the sender-connector is rendered available to serve another trunk to which it has access. Start relay 380 upon releasing closes a circuit for sender busy relay 370 extending from ground over its lower back contact, conductor 397, outer contacts of make-busy relay 410 of the seized No. 0 sender and over conductor 398 to battery through the upper winding of relay 370 whereupon relay 370 extends the start conductor from the sender-connector 300 to the winding of the start relay, such as 309, of a subsequent sender. Upon the closure of the selected set of cross-point contacts, six control conductors are extended from the calling trunk to the selected sender 403.

It is to be noted that any sender-connector may be removed from service by the operation of its individual make-busy relay such as 302 either by the insertion of a short-circuited plug into its associated make-busy jack 399 or over a circuit extending over the middle lower back contacts of all line relays of the connector and thence serially over the upper front contacts of sender busy relays 370 to 379 allocated to the sender-connector to ground should all senders become busy. When relay 302 operates it opens at its back contacts the operating circuits for all line relays 330 to 349 and over its front contacts connects ground to conductors 209 of all trunks which that sender-connector serves and thence to the sleeve conductors of the trunks to prevent such trunks from being seized by selector switches. Any sender may also be removed from service and marked as busy by the insertion of a short-circuited plug in the make-busy jack associated with its make-busy relay. Thus if a plug were inserted in the jack 420, relay 410 of the No. 0 sender would be operated to close a circuit through the operating windings of all sender busy relays such as 370 to 379 allocated to the No. 0 sender to prevent the seizure of such sender by any sender-connector.

It will be recalled that trunk relay 202 operated upon the completion of the dialing loop from the calling line to the trunk and therefore when the calling subscriber dialed the second office code digit A, which has a numerical digit value of 2, relay 202 releases in response to the first opening of the dial contacts upon the return of the dial and opens the circuit previously traced for relay 204. Relay 204, however, being slow to release, remains operated during the transmission of the remaining impulses of the second code digit series. With relay 204 operated and relay 202 released, a circuit is closed from ground at the back contact of relay 202 over the lower front contact of relay 204 thence in parallel over the No. 6 back contact of relay 203 through the winding of stepping

magnet 252 of digit register 250 and over the No. 7 back contact of relay 202 through the winding of slow-to-release relay 206 to battery and ground. Magnet 252 operates preparatory to advancing the brush 251 of switch 250 and relay 206 also operates. At the end of the first dial impulse with relay 202 reoperated, magnet 252 releases to advance brush 251 one step but relay 206 being slow to release remains operated. In response to the next operation and release of relay 202, magnet 252 advances brush 251 a second step. Since no further impulses are transmitted for the second code digit series, relay 202 now remains operated whereby the circuit of relay 206 is held open for a sufficient interval to permit its release.

Relay 206 upon releasing closes a circuit from ground over its back contact, the lower contacts of off-normal switch 210, which closed upon the first step advance of brush 251 of register 250, to battery through the winding of relay 203. Relay 203 upon operating opens at its Nos. 6 and 7 contacts the operating circuits for relay 206 and magnet 252; prepares at its No. 3 front contact the circuit for denied service relay 211; extends trunk conductors 200 and 201 over its Nos. 2 and 5 front contacts through condensers 212 and 213 to conductors 214 and 215, and at its Nos. 1 and 4 transfer contacts disconnects trunk conductors 200 and 201 from the windings of relay 202 and connects such conductors to the windings of the impulse responsive relay 430 of the sender 400. Relay 430 of the sender now operates over a circuit which may be traced from ground through its right winding, over conductor 431 of cable 432, No. 5 contacts of the operated cross-point contacts of sender-connector 300, conductor 216, inner upper normal contacts of cut-through relay 217, No. 1 alternate contacts of relay 203 over conductor 200 and the calling line loop, returning over conductor 201, the No. 4 alternate contacts of relay 203, the inner lower normal contacts of relay 217, conductor 218, No. 4 contacts of the operated cross-point contacts of sender-connector 300, thence over conductor 433 of cable 432 to battery through the left winding of relay 430. Relay 430 operates and closes an obvious circuit for slow-to-release relay 434 which upon operating connects ground over its left contact, conductor 435 of cable 432, No. 2 contacts of the operated cross-point contacts of sender-connector 300 to conductor 209 for locking hold magnet 310 and for supplying busy ground to the trunk sleeve conductor 107.

If following the operation of relay 203, a sender has not been connected to the trunk, the circuit of the denied service relay 211 is completed from battery through its winding over the No. 3 front contact of relay 203, conductor 303, back contact of relay 302, inner lower normal contacts of hold magnet 310 which will not have operated, conductor 209, back contact of relay 208, inner upper normal contacts of relay 207, through inductive resistance 255 to ground at the upper contacts of relay 204. Relay 211 upon operating locks over its inner lower front contact to ground on conductor 205 and establishes a circuit for transmitting an "all paths" busy tone to the calling line which may be traced from the source of tone current 219 over the inner upper front contact of relay 211, trunk conductor 201, thence over the calling line loop as previously traced and returning over trunk conductor 200, the lower front contact of relay 211 to ground through the upper winding of relay 202 to inform the subscriber

that the call cannot be served and that he should release the connection.

In response to the dialing of the third code letter R, which has a digit value 7, impulse responsive relay 430 of the sender releases in response to the first opening of the dialing circuit and closes a circuit extending from ground at its back contact, over the right contact of relay 434 which being slow to release does not release upon the momentary releases of relay 430, and thence through the winding of slow-to-release relay 436 to battery and in parallel therewith over brush 437 of steering switch 438 and the first terminal of its bank to battery through stepping magnet 439 of the first digit register 440. Relay 436 and magnet 439 thereupon operate, magnet 439 preparing to advance the brush 440 of register 441. At the end of the first impulse relay 430 re-operates opening the circuits of relay 436 and magnet 439, magnet 439 thereupon releasing to advance the brush 440 one step but relay 436 being slow to release remains operated during the transmission of the succeeding impulses of the third code digit series. In a similar manner relay 430 responds to the remaining impulses of the digit series and causes the step-by-step advance of brush 441 through six additional steps. At the end of the digit series relay 430 remains operated for a sufficient interval to permit relay 436 to release whereupon magnet 442 of the steering switch 438, which operated upon the operation of relay 436, is released to advance its brushes 437 and 455 one step. The brush of the digit register 441 has now been positioned on the No. 7 terminal of its bank. In a similar manner in response to the dialing of the numerical digits of the wanted line number, the digit registers 443, 444, 445 and 446 are operated under the control of their respective stepping magnets 447, 448, 449 and 450 in successive positions of the brush 437 of steering switch 438. Since as previously assumed the numerical digits of the wanted line are 1, 0, 0 and 0 the brushes 451, 452, 453 and 454 will be advanced respectively to their Nos. 1, 10, 10 and 10 bank terminal positions.

Since in one case to be later described, the first digit registered by register 441 may be the third office code digit, then as soon as this register has been set, indicating that all of the office code digits have been dialed and registered and, following the registration of this digit, the steering switch 438 has advanced one step from normal, a circuit is established to summon an idle decoder which circuit may be traced from ground over the contacts of off-normal switch 482 of the steering switch 438 and conductor 456 to battery through the winding of multi-contact relay 581, individual to the No. 0 sender 400, of the decoder-connector 580. The decoder-connector 580 is provided with a multicontact relay such as 561 individual to each sender and a multicontact relay 582 individual to each decoder and by a lock-out circuit (not shown), the multicontact relay of the first idle decoder is closed by the operated sender relay 581. It will be assumed, that in the order of preference the decoder disclosed in part in Figs. 1, 5 and 6 is the first idle decoder and that therefore the operation of sender relay 581 causes the operation of relay 582. The decoder upon being seized then proceeds to associate himself with the calling trunk over either one of two trunk decoder-connectors one of which is disclosed schematically at 150 in Fig. 1.

At this point it should be observed that all

groups of trunks are arbitrarily divided into A and B subgroups and that two connectors, such as 150, are provided. All groups of trunks will have their A subgroups served by connector 150 and their B subgroups served by the other connector. This arrangement permits uninterrupted service under trouble conditions or when maintenance conditions arise which make it desirable to remove one of the trunk decoder-connectors from service. To inform the decoder in which subgroup a calling trunk is located and therefore which of the two trunk decoder-connectors is to be used, a signal is transmitted from the trunk to the sender and the sender then signals the decoder. All trunks of the B subgroup are provided with battery connected to one terminal of their relays, corresponding to relay 220, and with ground connected to the upper swing contact of their denied service relays, corresponding to relay 211, and all trunks of the A subgroup are provided with ground connected to one terminal of their relays, corresponding to relay 220, and with battery connected through a non-inductive winding 221 of their relays, corresponding to relay 211, to the upper swing contacts of such relays. The connection of ground or battery to the terminal of relay 220 of any trunk therefore identifies the A or B subgroup in which the trunk is located.

It will now be assumed that the trunk shown in Fig. 2 is in the A subgroup and that therefore following the connection of the trunk to the sender 400, over the sender-connector 300, a circuit is established from ground through the winding of relay 220, upper back contact of relay 222, lower normal contacts of relay 207, conductor 223, No. 3 contacts of the operated cross-point contacts of the sender-connector 300 and conductor 457 of cable 432, back contact of out-pulsing relay 458 of the sender and back contact of relay 459 to battery through the winding of relay 460. Relays 220 and 460 thereupon operate, relay 460 causing relay 461 to operate and lock to off-normal ground. With relay 461 operated as soon as the decoder has been associated with the sender through the connection of ground to conductor 456, a circuit is established from ground on conductor 456 over the right front contact of relay 461, conductor 462 of cable 464, contacts of relays 581 and 582 of decoder-connector 580, conductor 500 of cable 591 to battery through the winding of relay 502 of the decoder. Relay 502 upon operating will cause the operation of multicontact relay 151 individual to the seized decoder of the trunk decoder-connector 150 over conductor 505 if such connector is available for the use of the decoder. If the calling trunk had been in the B subgroup and consequently battery had been connected to the winding of relay 220, the establishment of the previously traced circuit through the winding of sender relay 460 would not have caused the operation of relay 460 and consequently relay 461 would not have operated. Under this condition upon the connection of ground to conductor 456, a circuit would have been established from conductor 456 over the back contact of relay 461, conductor 463 of cable 464, contacts of relays 581 and 582 of the decoder-connector 580, conductor 503 of cable 591 to battery through the winding of relay 504. Relay 504 upon operating will cause the operation of a multicontact relay, corresponding to relay 151, individual to the decoder, of the second trunk decoder-connector

if such connector is available for the use of the decoder.

Relay 220 upon operating closes an outpulsing control circuit through the windings of the control relay of the selector switch in which the trunk terminates, over its outer contacts and the outer normal contacts of relay 230 through the retard coil 232 and the winding of polarized supervisory relay 233 over which circuit the control relay of the selector switch operates. Current does not, however, flow in the proper direction through the winding of polarized relay 233 to cause its operation. At its lower contact, relay 220 also closes a locking circuit for slow-to-release relay 204 extending from battery through the winding of relay 204 over such contacts to ground at the upper contacts of relay 204 for holding relay 204 operated during outpulsing and after relay 202 releases following the operation of relay 203 as previously described.

When relay 151 operates it establishes a circuit from battery over its No. 39 contacts, conductor 506, contacts of relays 582 and 581 of the decoder-connector 580, conductor 507 individual to the No. 0 sender 400, No. 1 contacts of the operated cross-point contacts of the sender-connector 300 and conductor 224 to battery through the winding of relay 135 of the calling trunk. Relay 135 operates closing an obvious operating circuit for multicontact relay 152 of the trunk decoder-connector 150, which relay is common to all trunks of the A group in which the calling trunk is assumed to be located; connects ground over conductor 136 to the brush 251 of the trunk register 250 and, following the operation of relay 152, with relay 151 operated from the decoder, connects code leads from one terminal of each of the code identifying resistances R0 to R9, T2 to T9 and TA1 to TA6 to winding terminals of register relays of the decoder and connects other miscellaneous control leads of the trunk to the decoder. The decoder now proceeds to determine the office code digits which were dialed by the calling subscriber.

For the purpose of enabling the decoder to determine the value of any office code digit dialed to seize the tandem trunk, three groups of low resistances are provided which may, by suitable cross-connections, be selectively included in the tip and ring conductors of the several incoming branches of the trunk. Resistance R0 is always connected to the ring conductor of every trunk branch which is accessible from a first selector and resistances R1 to R9 are connected to ring conductors of the trunk branches which are accessible to either second or third selectors, resistance R1 being connected to the ring conductors of all branches which terminate in the first bank levels of such switches, resistance R2 being connected to the ring conductors of all branches which terminate in the second bank levels of such switches, etc. Resistances T2 to T9 are connected to tip conductors of trunk branches which are accessible from either first or second selector switches, resistance T2 being connected to the tip conductors of all branches which terminate in the second bank levels of such switches, resistance T3 being connected to the tip conductors of all branches which terminate in the third bank levels of such switches, etc. Resistances TA1 to TA6 are cross-connected as may be required to the tip conductors of all branches which are accessible from third selector switches. Thus when a connection is established to the trunk over any one of its branches current will

flow through one of the R resistances and through one of either the T or TA resistances and the potential drop across such resistances may be used to inform the decoder as to the corresponding bank levels of selector switches which have been employed to establish the connection. This will be more apparent if a few concrete illustrations are considered.

If the first office code digit dialed has a numerical value 6, the first selector 102 will seize the trunk directly over the branch conductors 108 and 109 and the decoder must therefore be informed that the code digit 6 was dialed to reach the trunk. Therefore the tip conductor 108 is connected to one terminal of the T6 resistance. The decoder must also be informed that the second code digit dialed will be registered by the trunk register 250 and therefore the ring conductor is connected to one terminal of the R0 resistance. If the first code digit dialed has a numerical value of 7, the first selector 102 will seize the trunk directly over the branch conductors 110 and 111 and the decoder must be informed that the code digit 7 was dialed to reach the trunk. Therefore, the tip conductor 110 is connected to one terminal of the T7 resistance and as in the preceding illustration the ring conductor will be connected to one terminal of the R0 resistance. Thus, whenever a trunk is seized directly over any bank level of a first selector, a T resistance having a number corresponding to the bank level or value of the code digit dialed will be included in the tip branch of the trunk and the R0 resistance will be included in the ring branch of the trunk.

If the first office code digit dialed has the numerical value 3, the first selector will seize an idle second selector such as 103 over its third bank level and the selected second selector will be set in accordance with the value of the second code digit dialed. If the second selector is now set to its eighth bank level, the trunk will be seized thereby over the trunk branch conductors 112 and 113 and the decoder must therefore be informed that the first code digit dialed to set the first selector was 3 and that the second code digit dialed to set the second selector was 8. For this purpose the tip conductor 112 is connected to one terminal of the T3 resistance and the ring conductor 113 is connected to one terminal of the R8 resistance. Thus whenever a trunk is seized over a bank level of a second selector, the T resistance having a number corresponding to the bank level of the first selector over which the second selector was seized, will be included in the tip branch of the trunk and an R resistance having a number corresponding to the bank level of the second selector over which the trunk was seized, will be included in the ring branch of the trunk.

If the first selector is set to its third bank level in response to the dialing of the first code digit 3 to select the idle second selector 103 and the second selector is then set to its fourth bank level in response to the dialing of the second code digit 4 to select the idle third selector 105, then when the third code digit 5 is dialed, the third selector will be set to its fifth bank level and will seize the trunk over the tip and ring branch conductors 114 and 115. The decoder must therefore be informed that the first code digit dialed to set the first selector was 3, that the second code digit dialed to set the second selector was 4 and that the third code digit dialed to set the third selector was 5. For this purpose

the tip conductor 114 is connected to one terminal of the TA3 resistance which, when current flows therethrough, arbitrarily indicates to the decoder that the first two code digits dialed were 3 and 4 and the ring conductor 115 is connected to one terminal of the R5 resistance whereby when current flows therethrough it will indicate to the decoder that the last or third code digit dialed to reach the trunk was 5. As a last illustration, if the first selector is set to its third bank level in response to the dialing of the first code digit 3 to select the idle second selector 103 and the second selector is then set to its fifth bank level in response to the dialing of a second code digit 5 to select an idle third selector 104, then when the third code digit 6 is dialed, the third selector will be set to its sixth bank level and will seize the trunk over the tip and ring branches 116 and 117. The decoder must therefore be informed that the first code digit dialed to set the first selector was 3, that the second code digit dialed to set the second selector was 5 and that the third code digit dialed to set the third selector was 6. For this purpose the tip conductor 115 is connected to one terminal of the TA4 resistance which, when current flows therethrough, will arbitrarily indicate to the decoder that the first two digits dialed were 3 and 5 and ring conductor 117 is connected to one terminal of the R5 resistance whereby when current flows therethrough it will indicate to the decoder that the last of said code digits dialed to reach the trunk was 6.

From the foregoing illustrations it will be noted that current flowing through any T resistance will indicate the corresponding value of the first code digit dialed to reach the trunk, that current flowing through any TA resistance will arbitrarily indicate the values of the first and second code digits dialed when the trunk is seized after dialing three code digits and that current flowing through any R resistance will indicate the value of the last digit dialed to reach the trunk, which if the trunk is reached by dialing only one digit will be resistance R0 and which if the trunk is reached after dialing either two or three code digits will be one of resistances R1 to R9.

For registering the office code digits dialed to reach the trunk as indicated by current flowing through resistances of the T, TA or R groups, three groups of register relays are provided in the decoder, the group 120 of Fig. 1 comprising relays 122 to 129 which may be bridged around resistances T2 to T9, respectively, the group 509 of Fig. 5 comprising relays 510 to 519 which may be bridged around resistances R0 to R9, respectively, and the group 520 comprising relays 521 to 526 which may be bridged around resistances TA1 to TA6, respectively. For registering either a second or third office code digit or the thousands numerical digit which may be registered by the trunk register 250, a group 600 of register relays of Fig. 6 is provided comprising ten relays 601 to 610, inclusive, which are selectively operable in accordance with the bank terminal upon which the brush 251 of the trunk register 250 is positioned, and for registering a third office code digit which may be registered by register 441 of the sender, a further group 630 of register relays is provided comprising ten relays 611 to 620 which are selectively operable in accordance with the bank terminal upon which the brush 440 of register 441 is positioned.

Upon the operation of relays 135, 151 and 152 75

as previously described, the outer terminals of resistances R0 to R9 are connected over the Nos. 7 to 16 contacts of relay 135 and the Nos. 29 to 38 contacts of relays 151 and 152 to the upper terminals of the windings of register relays 510 to 519, respectively; the outer terminals of resistances T2 to T9 are connected over the Nos. 17 to 24 contacts of relay 135 and the Nos. 21 to 28 contacts of relays 151 and 152 to the upper terminals of the windings of register relays 122 to 129, respectively; the outer terminals of resistances TA1 to TA6 are connected over the Nos. 25 to 30 contacts of relay 135 and the Nos. 15 to 20 contacts of relays 151 and 152 to the upper terminals of the windings of register relays 521 to 526, respectively; the inner terminals of resistances T2 to T9 and TA1 to TA6 are connected over tip trunk conductor 200, conductor 130, the No. 5 contacts of relay 135, the No. 13 contacts of relays 151 and 152 and conductor 121 to the lower terminals of register relays 122 to 129 and 521 to 526; the inner terminals of resistances R0 to R9 are connected over ring trunk conductor 201, conductor 131, the No. 4 contacts of relay 135, the No. 12 contacts of relays 151 and 152 and conductor 527 to the lower terminals of register relays 510 to 519; the bank terminals 1 to 0 of trunk register 250 are connected over the Nos. 1 to 10 contacts of relays 151 and 152 and conductors of cable 532 to battery through the windings of register relays 601 to 610, respectively; a circuit is prepared for the denied service relay 211 of the trunk extending from battery therethrough, over conductor 132, the No. 3 contacts of relay 135 and No. 11 contacts of relays 151 and 152 to conductor 528 of cable 501, and a circuit is prepared for the metering relay 225 of the trunk from battery through its winding over conductor 226, the No. 6 contacts of relay 135 and the No. 14 contacts of relays 151 and 152 to conductor 529 of cable 501.

In the case first assumed, the trunk was seized over the No. 6 level of the first selector 102 and the dialing circuit previously traced through the windings of impulse responsive relay 430 of the sender, extends through the T6 resistance and through the R0 resistance. With relays 135, 151 and 152 now operated, the winding of relay 126 of the tip register 120 and the winding of relay 510 of the ring register 509 of the decoder are bridged around the T6 and R0 resistances, respectively. The bridging circuit of relay 126 may be traced from the lower terminal of resistance T6 over the No. 21 contact of relay 135, code conductor 118, No. 24 contacts of relays 152 and 151, conductor 119 through the winding of register relay 125, conductor 121, No. 13 contacts of relays 151 and 152, No. 5 contacts of relay 135, conductor 130 and conductor 200 to the upper terminal of resistance T6 and the bridging circuit of relay 510 may be traced from the lower terminal of resistance R0 over the No. 7 contacts of relay 135, the No. 38 contact of relays 152 and 151, conductor 508 through the winding of register relay 510, conductor 527, the No. 12 contacts of relays 151 and 152, the No. 4 contacts of relay 135, conductor 131 and conductor 201 to the upper terminal of resistance R0. Since current is flowing through resistances T6 and R0 as supplied through the windings of sender relay 430, current will therefore flow in parallel with such resistances through the windings of register relays 126 and 510 thereby causing their operation.

With relay 510 operated to indicate that no

second selector was set by a second dialed code digit to select the trunk and that therefore the second code digit was registered by the trunk register 250 and the third code digit was registered by the sender register 441, a circuit is established from ground at the No. 1 back contact of relay 530 and contacts of register relay 510 to battery through the winding of relay 531. Relay 531 upon operating associates the contacts of relays 601 to 610 of register 600 over conductors of group 621, the Nos. 11 to 20 contacts of relay 531, the Nos. 22 to 31 contacts of relays 581 and 582 of the decoder-connector and conductors of group B with the windings of relays of the B code digit register 469 of the sender; associates the contacts of relays 611 to 620 of the register 630 over conductors of group 622 over its Nos. 1 to 10 contacts, the Nos. 12 to 21 contacts of relays 581 and 582 and conductors of group C with the windings of relays of the C code digit register 470 of the sender and establishes a circuit from ground over its No. 21 contact, No. 52 contacts of relays 581 and 582, conductor 465 to battery through the winding of multicontact relay 466 of the sender. Relay 466 operates to perform switching operations to be later described.

Register relay 126 upon operating closes a circuit from ground over its contacts, a conductor of cable 133, the No. 35 contacts of relays 581 and 582, a conductor of group A to battery through the winding of the No. 6 relay (not shown) of the A code digit register 468 of the sender thereby registering in the sender that the first office code digit dialed has a numerical value of 6. It will be recalled that the second code letter dialed was A and that the brush 251 of the trunk circuit 250 was therefore advanced two steps to its No. 2 bank terminal. A circuit is therefore effective from ground applied by relay 135 over conductor 136 to brush 251, thence over the No. 2 terminal of its bank, thence over the No. 9 contacts of relays 151 and 152, a conductor of cable 532 to battery through the winding of relay 602 of register 600. Relay 602 thereupon operates establishing a circuit from ground over its contacts, a conductor of the group 621, the No. 19 contacts of relay 531, the No. 30 contacts of relays 581 and 582 and a conductor of the B group to battery through the winding of the No. 2 relay of the B code digit register 469 of the sender. It will be recalled that the brush 440 of the digit register 441 of the sender was advanced into engagement with its No. 7 bank terminal in response to the dialing of the third office code letter R and therefore with the brush 455 of the steering switch 438 in its No. 1 off-normal position, a circuit is closed from ground at brush 455, thence over the No. 1 off-normal terminal of its associated bank, brush 440 and the No. 7 terminal of its bank, the No. 7 front contact of operated relay 466, thence over a conductor of the group SR, the No. 5 contacts of relays 581 and 582 and a conductor of the group 623 to battery through the winding of relay 617 of the decoder register 630. Relay 617 thereupon operates and closes a circuit from ground over its contacts, a conductor of the group 622, the No. 4 contacts of relay 531, the No. 15 contacts of relays 581 and 582 and a conductor of the group C to battery through the winding of the No. 7 relay of the C code digit register 470 of the sender. The sender has now registered the complete information with respect to the three office code digits dialed by the calling subscriber.

It will be recalled that brush 451 of sender

register 443 was advanced to its first bank terminal in response to the dialing of the thousands digit 1 and therefore upon the completion of the registration of this digit, at which time brush 455 of steering switch 438 will be in its No. 2 off-normal terminal position, a circuit is established from ground over brush 455 and this bank terminal, brush 451 and the first terminal of its bank, the No. 11 front contact of relay 466 to battery through the winding of the No. 1 relay of the thousands digit register 471. The brush 452 of register 444 was advanced to its tenth bank terminal in response to the dialing of the hundreds digit 0 and therefore upon the advance of brush 455 following the setting of register 444 a circuit is established from ground over brush 455 and its No. 3 off-normal bank terminal, brush 452 and its tenth bank terminal, the No. 30 front contact of relay 466 to battery through the winding of the No. 0 relay of the hundreds digit register 472. The brush 453 of register 445 was advanced to its tenth bank terminal in response to the dialing of the tens digit 0 and therefore upon the advance of brush 455 following the setting of register 445, a circuit is established from ground over brush 455 and its No. 4 off-normal bank terminal, brush 453 and its tenth bank terminal, the No. 40 front contact of relay 466 to battery through the winding of the No. 0 relay of the tens digit register 473. The brush 454 of register 446 was advanced to its tenth bank terminal in response to the dialing of the units digit 0 and therefore upon the advance of brush 455 following the setting of register 446, a circuit is established from ground over brush 455 and its No. 5 off-normal bank terminal, brush 454 and its tenth bank terminal, the No. 50 front contact of relay 466 to battery through the winding of the No. 0 relay of the units digit register 474. All of the called line designation digits have now been registered by the registers 468 to 474, inclusive of the printer control circuit 480 of the sender.

As further illustrative of the functioning of the decoder to register the office code information and to transfer it to the office code registers of the sender, it will be assumed that the calling subscriber has dialed an office designation, the letters of which have the numerical equivalents 3, 8, 7 in which case the connection is established to the trunk over the third bank level of the first selector 102 and over the eighth bank level of the second selector 103. The third office code digit 7 is registered by the trunk register 250 and the four numerical digits of the wanted line designation are registered by sender registers 441, 443, 444 and 445, respectively. Following the seizure of the sender, current flows over the calling line loop through the tip resistance T3, the ring resistance R3 and the windings of impulse responsive relay 430 of the sender. As soon as a digit has been registered in the sender by register 441 which, in this case will be the thousands digit, the decoder is seized over the decoder-connector 530 and the decoder is associated with the trunk over the trunk decoder-connector 150 in the manner previously described. With current flowing through resistance T3, relay 123 of the decoder register 120 is now operated. With current flowing the resistance R3, relay 518 of the decoder register 500 is also operated and with the trunk register brush 251 positioned upon the No. 7 terminal of its bank in response to the dialing of the third

code digit 7, relay 607 of the decoder register 600 is operated.

With register relay 518 operated, a circuit is established from ground at the No. 1 back contact of relay 530 over the outer front contact of relay 518 to battery through the winding of relay 533 which thereupon operates to connect the front contacts of all relays of register 600 over conductors of group 621, the Nos. 12 to 21 contacts of decoder-connector relays 581 and 582 and the conductors of the group C to the windings of relays of the C code digit register 470 of the sender. It is to be noted in this connection that relay 533 will operate if any of the relays 511 to 519 of the decoder register 509 operate thereby indicating that the trunk has been seized in response to the dialing of two office code digits and that the third office code digit dialed has been registered by the trunk register 250, transferred to the decoder register 600, and should be transferred from such decoder register to the C code digit register 470 of the sender.

With register relay 123 operated, a circuit is established from ground over its contacts, a conductor of cable 133, the No. 38 contacts of relays 581 and 582 and a conductor of the A group to battery through the winding of the No. 3 relay of the A code digit register 468 of the sender. With register relay 518 operated, a circuit is established from ground over the inner front contact of relay 518, the No. 33 back contact of relay 530, the No. 23 contacts of relays 581 and 582 and a conductor of the B group to battery through the winding of the No. 8 relay of the B code digit register 469 of the sender. With register relay 607 and relay 533 operated, a circuit is established from ground over the front contacts of relay 607, a conductor of group 621, the No. 4 contact of relay 533, the No. 15 contacts of relays 581 and 582, and a conductor of the C group to battery through the winding of the No. 7 relay of the C code digit register 470 of the sender.

Since under the condition assumed neither relay 466 nor 467 of the sender has been operated, the setting of sender register 441, in accordance with the thousands digit dialed, is not transferred to the decoder register 600 but is transferred over one of the Nos. 1 to 10 back contacts of relays 466 and 467 to the winding of one of the relays of the thousands digit register 471 of the sender as soon as the steering switch brush 455 reaches its No. 1 off-normal bank terminal following the completion of the setting of register 441; the setting of sender register 443, in accordance with the hundreds digit dialed, is transferred over one of the Nos. 11 to 20 back contacts of relays 466 and 467 to the winding of one of the relays of the hundreds digit register 472 as soon as the steering switch brush 455 reaches its No. 2 off-normal terminal following the completion of the setting of register 443; the setting of sender register 444, in accordance with the tens digit dialed, is transferred over one of the Nos. 21 to 30 back contacts of relays 466 and 467 to the winding of one of the relays of the tens digit register 473 of the sender as soon as the steering switch brush 455 reaches its No. 3 off-normal terminal following the completion of the setting of register 444 and the setting of register 445, in accordance with the units digit dialed, is transferred over one of the Nos. 31 to 40 back contacts of relays 466 and 467 to the winding of one of the relays of the units digit register 474 as soon as the steering switch brush 455 reaches its No. 4 off-normal terminal

following the completion of the setting of register 445.

To further illustrate the manner in which the decoder registers the office code information and transfers it to the office code registers of the sender, it will be assumed that the calling subscriber has dialed an office designation, the letters of which have the numerical equivalents 3, 4, 5 in which case the connection is established to the trunk over the third bank level of the first selector 102, over the fourth bank level of the second selector 103 and over the fifth bank level of the third selector 105, the thousands numerical digit dialed being registered by the trunk register 250 and the hundreds, tens and units numerical digits being registered by sender registers 441, 443 and 444, respectively. Following the seizure of the sender, current flows over the calling line loop through the tip resistance TA3, the ring resistance R5, and the windings of impulse responsive relay 430 of the sender. As soon as a digit has been registered in the sender by register 441, which in this case will be the hundreds digit, the decoder is seized over the decoder-connector 580 and the decoder is associated with the trunk over the trunk decoder-connector 150 in the manner previously described. With current flowing through resistance TA3, relay 523 of the decoder register 520 is now operated. With current flowing through resistance R5, register relay 515 of the decoder register 509 is also operated and with the trunk register brush 251 positioned upon a terminal of its bank in response to the dialing of the thousands digit, a relay of the decoder register 600 is operated.

With relay 523 of the decoder register 520 operated, an obvious circuit is closed over its outer front contact to battery through the winding of relay 530 which thereupon operates to connect the inner contacts of relays 511 to 519 of register 509, over its Nos. 32 to 40 front contacts, the Nos. 12 to 21 contacts of relays 581 and 582 and conductors of the group C to windings of relays of the C code digit register 470 of the sender; to connect the inner front contacts of relays of decoder register 520, strapped to terminals of terminal block 534 over conductors of the group 535, the Nos. 22 to 31 front contacts of relay 530, the Nos. 32 to 41 contacts of relays 581 and 582 and conductors of the group A, windings of relays of the A code digit register 468 of the sender and over conductors of the group 536, the Nos. 12 to 21 front contacts of relay 530, the Nos. 22 to 31 contacts of relays 581 and 582 and conductors of the group B to the windings of the relays of the B code digit register 469 of the sender; to connect contacts of the relays of the decoder register 600 over conductors of the group 621, the Nos. 2 to 11 front contacts of relay 530, the Nos. 42 to 51 contacts of relays 581 and 582, and conductors of the group TH to the windings of the relays of thousands digit register 471 of the sender; at its No. 1 back contact to open the operating circuit of relay 533 to prevent its operation at this time and to close a circuit extending over its No. 1 front contact, the No. 53 contacts of relays 581 and 582 and conductor 475 to battery through the winding of relay 467 in the sender. Relay 467 thereupon operates to inform the sender that the thousands digit has been registered by the trunk register 250 and that the hundreds, tens and units digits have been registered on the sender registers 441, 443 and 444.

Register relay 523, since it has been operated to arbitrarily indicate that the first two code dig-

its dialed to reach the trunk were 3 and 4, has its inner front contact strapped to terminals on the block 534 to which the third conductor of the group 535 is connected and to which the fourth conductor of the group 536 is connected. Thus when relay 523 operates, a circuit is closed from ground over its inner contact, the No. 3 conductor of the group 535, the No. 29 contact of relay 530, the No. 39 contacts of relays 581 and 582 and a conductor of group A to battery through the winding of the No. 3 relay of the A code digit register 468 of the sender and a circuit is also closed from ground over its inner contact, No. 4 conductor of the group 536, No. 18 contact of relay 530, the No. 28 contacts of relays 581 and 582 and a conductor of group B to battery through the winding of the No. 4 relay of the B code digit register 469 of the sender. Register relay 515 upon operating is not effective to establish the circuit of relay 533 since relay 530 is operated, but closes a circuit from ground over its inner front contact, the No. 36 front contact of relay 530, the No. 16 contacts of relays 581 and 582 and a conductor of group C to battery through the winding of the No. 5 relay of the C code digit register 470 of the sender. With a relay of the decoder register 600 operated in accordance with the setting of the trunk register 250 in response to the dialing of the thousands digit, such operated relay closes a circuit from ground over its contact, a conductor of the group 621, one of the contacts 2 to 11 of relay 530, one of the contacts 42 to 51 of relays 581 and 582 and a conductor of the group TH to battery through the winding of one of the relays of the thousands digit register 471 of the sender.

Since under the condition assumed, relay 466 of the sender is not operated and relay 467 is operated, the setting of sender register 441 in accordance with the hundreds digit dialed is transferred over one of the Nos. 1 to 10 back contacts of relay 466 and one of the Nos. 1 to 10 front contacts of relay 467 to the winding of one of the relays of the hundreds digit register 472 of the sender as soon as the steering switch brush 455 reaches its No. 1 off-normal bank terminal; the setting of sender register 443 in accordance with the tens digit dialed is transferred over one of the Nos. 11 to 20 back contacts of relay 466 and one of the Nos. 11 to 20 front contacts of relay 467 to the winding of one of the relays of the tens digit register 473 of the sender as soon as the steering switch brush 455 reaches its No. 2 off-normal bank terminal and the setting of sender register 444 in accordance with the units digit dialed is transferred over one of the Nos. 21 to 30 back contacts of relay 466 and one of the Nos. 21 to 30 front contacts of relay 467 to the winding of one of the relays of the units digit register 474.

The sender now has complete information for extending the connection to the wanted line and to control the printing of the directory number of the wanted line on a toll ticket. While the decoder is obtaining the called office code information, it may also proceed to identify the calling line and cause the identifying digits to be registered on the calling line identification registers of the sender in the manner fully disclosed in the application of J. W. Gooderham hereinbefore referred to.

The class of the calling line will be indicated by the operation of one of the calling line identification register relays of the sender and this class registration in conjunction with the set-

ting of the called office code registers 468, 469 and 470 will determine whether the call should be ticketed, whether the message register of the calling line should be operated or whether service on the attempted connection should be denied. If it is determined that the call should be registered, a circuit is established from ground in the sender, over conductor 476 of cable 464, No. 54 contacts of relays 581 and 582, conductor 529 of cable 501, No. 14 contacts of relays 151 and 152, No. 6 contacts of relay 135 and conductor 226 to battery through the winding of metering relay 225 whereupon relay 225 will operate and lock over its inner upper front contact to ground on conductor 205 preparatory to controlling the circuit of relay 227 following the response of the called subscriber. If it is determined that the call should be denied to the calling subscriber, a circuit is established from ground in the sender over conductor 477 of cable 464, the No. 55 contacts of relays 581 and 582, conductor 528 of cable 501, the No. 11 contacts of relays 151 to 152, the No. 3 contacts of relay 135 and conductor 132 to battery through the winding of denied service relay 211 whereupon relay 211 will operate, lock over its inner lower front contact to ground on conductor 205 and will transmit an "all-paths" busy tone signal to the calling line from the source 219 as previously described.

At the time relay 152 of the trunk decoder-connector operated to connect the decoder with the subgroup of ten trunks in which the calling trunk was located, it established a circuit from ground over the inner contacts of relay 152 and an inner contact of relay 151, conductor 134 of cable 501, contacts of relay 581 to 582 and conductor 478 of cable 464 to battery through the winding of relay 391 individual to the No. 0 sender which operates and in turn operates the multicontact relay 392 of the trunk sender-connector 390 which has access to the group of twenty trunks in which the calling trunk is located. It is to be noted that as many trunk sender-connectors, such as 390 are provided as there are groups of trunks and that each sender is provided with as many relays, such as 391, as there are trunk groups, such relays being selectably operable over conductors such as 478 of cable 475 in accordance with which trunk group relay 152 of the trunk decoder-connector is operated. When all necessary information has been received by the sender, the sender removes ground from conductor 456 thereby releasing relay 581 of the decoder-connector 580 individual to the sender whereupon the decoder is released from its association with the sender by the release of relay 581, is released from its association with the trunk by the release of the relay 151 and all operated apparatus of the decoder is released. The decoder also releases relay 135 of the trunk. The sender now proceeds to complete its two functions, namely, the transmission of impulses to the trunk to complete the desired connection and printing the necessary information on the toll ticket. These two functions are performed simultaneously.

To complete the connection from the sender to the calling trunk over the trunk sender-connector 390, the sender when it is ready to start the transfer of information from its control registers to the ticket printer 269 of the calling trunk, connects battery to conductor 479 of cable 432 thereby completing a circuit over the No. 6 contacts of the operated cross-point contacts of sender-connector 390, conductor 228

to ground through the winding of relay 229. Relay 229 thereupon operates closing an obvious circuit for multicontact relay 393 individual to the ten trunks in which the calling trunk is located which relay is located in the trunk sender-connector 390 whereby a plurality of printer control circuits is established from the printer control circuit of the sender 490, indicated by the box 490 and including the calling line identification registers (not shown) and the called line digit registers 468 and 474, to the printer 250 over contacts 2 to 5 of relay 229 and contacts of relays 392 and 393 of the trunk sender-connector 390. The sender then proceeds to control the printer to print on a toll ticket the identification digits of the calling line and the digits of the called line directory number.

For controlling the setting of selector switches in accordance with the office code and numerical digits registered by the registers 468 to 474, the sender in the well-known manner causes the operation of pulsing relay 458 to transmit series of impulses over the previously traced circuit through the winding of pulsing relay 220 of the trunk. Upon each opening of the pulsing circuit through the winding of relay 220, relay 220 releases to open the outpulsing circuit to the selector switch in which the trunk terminates, to open the locking circuit of relay 204 which relay being slow to release does not release upon the momentary releases of relay 220 and to close a circuit for relay 230, extending from battery through the winding thereof, the upper back contact of relay 220 to ground on conductor 295. Relay 230 being slow to release remains operated during the transmission of each impulse series. With relay 230 operated the retard coil 232 and winding of relay 233 are shunted from the outpulsing circuit by a circuit extending over the inner upper front contact of relay 230 through resistance 231, and when relay 230 releases at the end of each impulse transmitted from the sender, ground through resistance 234 is connected over the upper alternate contacts of relay 230 and the upper contacts of relay 220 to the tip conductor 235 of the trunk and battery through resistance 236 is connected over the lower alternate contacts of relay 230 and the inner lower contacts of relay 220 to the ring conductor 237 of the trunk to assist the control relay of the selector in releasing to thereby increase the pulsing range. In this manner successive selector switches are controlled by the sender to complete the connection to the wanted line.

After the sender has completed its functions, it establishes a circuit from ground over conductor 481, the outer contacts of relays 392 and 393 of the trunk sender-connector 390, conductor 238 and the No. 6 contacts of relay 229 to battery through the winding of cut-through relay 217 which operates and locks to ground on conductor 205; closes an obvious circuit for relay 207; opens at its inner normal contacts the previously traced loop circuit from the calling line through the windings of relay 430 of the sender; closes a circuit for slow-to-release relay 243 extending from ground at its lower front contact over the No. 9 back contact of relay 242, the lower back contact of relay 225 if the call is to be ticketed and relay 225 has not been operated, to battery through the winding of relay 243; and at its inner alternate contacts establishes a supervisory circuit from ground through the upper winding of relay 202, upper normal contacts of relay 227, 75

upper alternate contacts of relay 217, No. 1 alternate contacts of relay 203 thence as traced over the calling line loop and returning over the No. 4 alternate contacts of relay 203, the lower alternate contacts of relay 217, the lower normal contacts of relay 227, to battery through the lower winding of relay 202. Relay 202 now operates and closes the original operating circuit of slow-to-release relay 204. Relay 207 upon operating establishes a holding circuit for relay 220 which extends from battery or ground, dependent upon whether the trunk is located in an A or B subgroup, through the winding of relay 220, the upper back contact of relay 222, the lower alternate contacts of relay 207 to ground or battery over the upper back contact of relay 211. This locking circuit is established prior to the opening of the pulsing circuit extending through the winding of relay 220 from the sender. Relay 207 also at its upper normal contacts disconnects the sleeve conductor 107 of the trunk from the previously traced circuit extending over conductor 209 through the sender-connector 390 to ground at the left front contact of relay 434 of the sender and over its upper alternate contacts connects the sleeve conductor 107 to ground at the upper front contacts of relay 204. Upon the opening of the circuit of relay 430 of the sender, relay 430 releases in turn releasing relay 434 and starting the release of all operated apparatus of the sender. Relay 434 upon releasing removes ground from the locking circuit of hold magnet 310 of the sender-connector which thereupon releases to disconnect the sender from trunk at the sender-connector 390. The sender upon releasing also releases relays 229, 391, 392 and 393 thereby disconnecting the sender from the trunk at the trunk sender-connector 390.

When the called subscriber answers, a battery reversal is received over the trunk conductors 235 and 237 which with relay 220 operated and relay 230 released following the termination of the last digit series of impulses transmitted from the sender, causes the operation of the polarized supervisory relay 233. Relay 233 upon operating closes a circuit from ground at the upper contact of relay 217 over its front contact and the lower front contact of relay 225 to battery through the winding of message register control relay 227, if relay 225 has been previously operated, to operate the calling subscriber's message register for those calls for which no ticket is required. If relay 227 operates, it reverses the connection of battery and ground supplied through the windings of relay 202 over the calling line loop for the purpose of operating the message register of the calling line in a well-known manner.

Relay 233 also closes a circuit from ground over the upper contact of relay 217 and its own front contact to conductor 239 and the cam spring of interrupter 240 whereby when the cam spring engages its lower contact, a circuit is established through the winding of relay 241 to battery thereby operating relay 241 which locks to ground on conductor 239 and prepares a circuit for relay 242. After an interval when the cam spring engages its upper contact, the circuit of relay 242 is completed from ground on conductor 239 over the upper contact of the spring, lower front contact of relay 241, and the lower normal contacts and winding of relay 242 to battery. Relay 242 thereupon operates and locks over its No. 1 alternate contacts to ground at the lower front contact of relay 217. A delay interval of from two to four seconds is thus in-

roduced after the called subscriber has answered before the printer 260 can be operated to print an identification that the called subscriber has answered to prevent charging on half-second trunk reversals for ticketed calls to busy lines and to prevent charging on ticketed calls in which case a momentary reversal may be received when the call is answered by an intercepting operator.

When relay 242 operates, it opens at its No. 9 contacts, the previously traced operating circuit for relay 243, but relay 243 being slow to release remains operated momentarily to close a circuit from ground over the No. 4 contacts of relay 242 and the contacts of relay 243 to the printer 260 to cause the printer to print the trunk number on the toll ticket as an indication that the called subscriber has answered. Relay 242 also connects a source of alternating current over its Nos. 7 and 8 contacts to the motor of the timer 244; connects the winding of relay 241 over its No. 5 contacts directly to conductor 239; prepares a locking circuit for relay 222 over its No. 3 contacts and prepares a circuit for the automatic trunk release circuit enclosed in the dot-dash rectangle 246. The timer 244 starts from its normal position immediately upon the closure of its operating circuit, and at intervals of one minute closes a circuit from ground at the upper front contacts of relay 207 over the upper back contacts of relay 225, over contacts 245 operated by the timer to the printer 260 to cause the printer to print the trunk number on a toll ticket at one-minute intervals thus recording the number of one minute-intervals of conversation.

When disconnection by the calling subscriber occurs relays 202 and 204 release. Relay 204 upon releasing releases relay 217 and relays 211 and 225, if operated, removes ground from sleeve conductor 107 thereby releasing the connection toward the calling line and with relay 202 released closes the circuit of release magnet 253 of the register 250 which may be traced from ground at the back contact of relay 202, the lower back contact of relay 204 and the upper contacts of off-normal switch 210 to battery through the winding of release magnet 253 whereby register 250 is restored to normal. When the register reaches its normal position, the off-normal contacts are opened thereby releasing relay 203. Relay 217 upon releasing releases relays 207, 241 and 242 and relay 242 upon releasing stops the timer 244 in its normal position. Relay 207 upon releasing releases relay 220 whereupon relay 233 is released and the release of the connection toward the called line is initiated.

Should the tape or ticket supply become exhausted, the end of tape contact 261 of the printer 260 will be closed thereby operating relay 208 which opens at its back contact the circuit for initiating the seizure of an idle sender and which at its front contact connects busy ground to the sleeve conductor 107 of the trunk to prevent the seizure of the trunk. If desired, relay 208 upon operating may close an alarm circuit to indicate to a maintenance man that the ticket printer requires attention.

It is desirable that the connection from the trunk to the tandem office be released automatically after an interval in the event that the called subscriber should disconnect and the calling subscriber fail to disconnect. Thus if relay 233 releases due to the called subscriber disconnecting and after relay 242 has operated, a circuit is established from ground at the upper front contact of relay 217, back contact of relay 233, No. 5

6 contacts of relay 242 and conductor 247 to battery through the winding of slow-to-release relay 248 as soon as interrupter contacts 249 close. Relay 248 upon operating locks over its inner contacts to ground on conductor 247, independent of interrupter contacts 249. Interrupter contacts 251 will close two minutes later and if relays 242 and 248 are then still operated and with relay 241 released, a circuit is closed from battery through the winding and normal contacts of relay 222, back contacts of relay 241, No. 2 contacts of relay 242, upper contacts of relay 248 to ground at interrupter contacts 254 and relay 222 will lock over its alternate contacts to ground at the No. 3 contacts of relay 242 and will open at its upper back contacts the circuit of relay 220 which will thereupon release. The release of relay 220 causes the release of all switches toward the called line thereby freeing the called line. When the calling subscriber disconnects, the remaining operated apparatus of the trunk circuit then releases in the manner previously described.

What is claimed is:

1. In a telephone system, a calling line, a plurality of trunks over which connections may be extended to any one of a plurality of offices, a train of selector switches responsive to the dialing of one or more of the office code digits of any desired office for extending a connection from said calling line to an idle one of said trunks, means in each of said trunks for determining the values of the office code digit or digits dialed to seize said trunk, and means operable in accordance with said determining means for registering the office code digit or digits dialed to seize said trunk.

2. In a telephone system, a calling line, a train of selector switches, a plurality of trunks certain of which are accessible respectively from different switches of said train and others of which are provided with branches accessible from one or more switches of said train in response to the dialing of one or more of the office code digits of any desired office, means in each of said trunks for determining the values of the office code digit or digits dialed to seize said trunk, and means operable in accordance with said determining means for registering the office code digit or digits dialed to seize said trunk.

3. In a telephone system, a trunk having resistance networks, means for selecting said trunk in response to digit impulses and means controlled by said resistance networks for determining the digital values of said impulses.

4. In a telephone system, a calling line, a plurality of trunks over which connections may be extended to any one of a plurality of offices, a train of selector switches responsive to the dialing of one or more of the office code digits of any desired office for extending a connection from said calling line to an idle one of said trunks, resistance networks in each of said trunks for determining the values of the office code digit or digits dialed to seize said trunk, and means responsive to said networks for registering the office code digit or digits determined thereby.

5. In a telephone system, a calling line, a train of selector switches, a plurality of trunks certain of which are accessible respectively from different switches of said train and others of which are provided with branches accessible from one or more switches of said train in response to the dialing of one or more of the office code digits of any desired office, resistance networks in each of said trunks for determining the values of the of-

office code digit or digits dialed to seize said trunks, and means responsive to said networks for registering the office code digit or digits determined thereby.

6. In a telephone system, a calling line, a trunk over which connections may be extended to any one of a plurality of offices, a train of selector switches responsive to the dialing of one or more of the office code digits of any desired office for extending a connection from said calling line to said trunk, said trunk having branches terminating in the banks of the several switches of said train, each branch being indicative of the office code digits dialed to extend a connection to said trunk, and means operable in accordance with the particular branch over which said trunk is selected for registering the code digit or digits dialed to select that branch.

7. In a telephone system, a calling line, a trunk over which connections may be extended to any one of a plurality of offices, a train of selector switches responsive to the dialing of one or more of the office code digits of any desired office for extending a connection from said calling line to said trunk, said trunk having branches terminating in the banks of the several switches of said train, means in each branch energizable upon the seizure of the trunk over such branch indicative of the office code digits dialed to seize the trunk, and means operable in accordance with said means for registering the code digit or digits dialed to select said trunk.

8. In a telephone system, a calling line, a trunk over which connections may be extended to any one of a plurality of offices, a train of selector switches responsive to the dialing of one or more of the office code digits of any desired office for extending a connection from said calling line to said trunk, said trunk having a tip conductor provided with as many branches each including a resistance as there are possible values of the first office code digit dialed to reach said trunk and having a ring conductor provided with as many branches each including a resistance as there are possible values of a last code digit dialed to reach said trunk, different pairs of said tip and ring branches being accessible from different bank levels of said switches, each pair including a tip resistance indicative of the value of the first code digit and a ring resistance indicative of the value of the last code digit dialed to select the trunk thereover, a battery effective upon the seizure of said trunk to cause current to flow through the resistances of the pair of branch conductors over which said trunk was seized, groups of register relays and means for bridging the relays of said groups around said tip and said ring resistances whereby a relay of each of said groups is selectively operable in accordance with the tip and ring resistances through which current is flowing to register the values of the code digits dialed to reach said trunk.

9. In a telephone system, a calling line, a plurality of trunks over which connections may be extended to any one of a plurality of offices, a train of selector switches responsive to the dialing of one or more of the office code digits of any desired office for extending a connection from said calling line to an idle one of said trunks, each of said trunks having a tip conductor provided with as many branches each including a resistance as there are possible values of the first office code digit dialed to reach said trunk and having a ring conductor provided with as many branches each including a resistance as

there are possible values of a last office code digit dialed to reach said trunk, different pairs of said tip and ring branches being accessible from different bank levels of said switches, each pair including a tip resistance indicative of the value of the first code digit and a ring resistance indicative of the value of the last code digit dialed to select the trunk thereover, a battery effective upon the seizure of a trunk to cause current to flow through the resistances of the pair of branch conductors over which said trunk was seized, groups of register relays common to said trunk, and means responsive to the seizure of a trunk for bridging the relays of said groups around the tip and ring resistances of said trunk whereby a relay of each of said groups is selectively operable in accordance with tip and ring resistance through which current is flowing to register the values of the code digits dialed to reach the idle trunk.

10. In a telephone system, a calling line, a trunk over which connections may be extended to any one of a plurality of offices, a selector switch responsive to the dialing of the first office code digit of a desired office for extending a connection from said calling line to said trunk, said trunk having a tip conductor provided with as many branches each including a resistance as there are possible values of said first office code digit, and having a ring conductor provided with a plurality of branches each including a common resistance, different pairs of said tip and ring branches being accessible from different bank levels of said selector switch, each pair including a tip resistance indicative of the value of the code digit dialed to select the trunk thereover and the common ring resistance indicative that no second code digit was dialed to select the trunk, a battery effective upon the seizure of the trunk to cause current to flow through the resistance of the pair of branch conductors over which said trunk was seized, register relays and means for bridging said relays around said resistances whereby said relays are selectively operable in accordance with the tip and ring resistances through which current is flowing to register the value of the single code digit dialed to reach the trunk and to register the fact that but one code digit was dialed to reach the trunk.

11. In a telephone system, a calling line, a trunk over which connections may be extended to any one of a plurality of offices, a train of selector switches including first, second and third selector switches responsive to the dialing of the three office code digits of any desired office for extending a connection from said calling line to said trunk, said trunk having a tip conductor provided with as many branches each including a resistance as there are combinations of values of first and second office code digits dialed to reach said trunk, and having a ring conductor provided with as many branches each including a resistance as there are possible values of a third office code digit dialed to reach said trunk, different pairs of said tip and ring branches being accessible from different bank levels of said third selector switches, each pair including a tip resistance indicative of the values of the first and second code digits and a ring resistance indicative of the value of the third code digit dialed to select the trunk thereover, a battery effective upon the seizure of said trunk to cause current to flow through the resistances of the pair of branch conductors over which said trunk was seized, groups of register relays, and means for

bridging the relays of said groups around said tip and ring resistances whereby a relay of each group is selectively operable in accordance with the tip and ring resistances through which current is flowing to register the values of the three code digits dialed to reach said trunk.

12. In a telephone system, a calling line, a trunk over which connections may be extended to any one of a plurality of offices, a train of selector switches responsive to the dialing of one or more of the office code digits of any desired office for extending a connection from said calling line to said trunk, said trunk having branches terminating in the banks of the several switches of said train, each branch being indicative of the office code digits dialed to extend a connection to said trunk, a register in said trunk operable in response to the digit dialed following the seizure thereof, and means operable in accordance with the particular branch over which said trunk is selected and in accordance with the setting of said trunk register for registering the office code digits dialed.

13. In a telephone system, a calling line, a trunk over which connections may be extended to any one of a plurality of offices, a train of selector switches responsive to the dialing of one or more of the office code digits of any desired office for establishing a connection from said calling line to said trunk, said trunk having branches terminating in the banks of several switches of said train, each branch being indicative of the office code digits dialed to extend a connection to said trunk, a register in said trunk operable in response to the digit dialed following the seizure thereof, a sender associable with said trunk upon the seizure thereof, registers in said sender responsive to the dialing of the remaining digits of the wanted line designation and means operable in accordance with the particular branch over which said trunk is selected and in accordance with the settings of said trunk register and of the first of said sender registers when office code digits are registered thereby for registering all of the office code digits dialed.

14. In a telephone system, a calling line, a trunk over which connections may be extended to any one of a plurality of offices, a first selector switch responsive to the dialing of a first office code digit for extending a connection from said calling line to said trunk, a register in said trunk responsive to the second office code digit dialed, a sender associable with said trunk upon the seizure thereof, a register in said sender responsive to the third office code digit dialed, means in said trunk for determining the value of the first office code digit dialed and for indicating that the second code digit dialed is registered by said trunk register, office code digit registers, means responsive to said determining means for causing the operation of one of said last-named registers to register the first code digit, and means responsive to said indicating means for causing the operation of the other of said last-named registers to register the second and third code digits in accordance with the setting of said trunk and sender registers, respectively.

15. In a telephone system, a calling line, a trunk over which connections may be extended to any one of a plurality of offices, first and second selector switches responsive to the dialing of first and second office code digits for extending a connection from said calling line to said trunk, a register in said trunk responsive to the

third office code digit dialed, means in said trunk for determining the values of the first and second office code digits, office code digit registers, means responsive to said determining means for causing the operation of a first and second of said last-named registers to register the first and second office code digits, and means responsive to said determining means for causing the operation of a third of said last-named registers to register the third office code digit in accordance with the setting of said trunk register.

16. In a telephone system, a calling line, a trunk over which connections may be extended to any one of a plurality of offices; first, second and third selector switches responsive to the dialing of first, second and third office code digits of a wanted line designation for extending a connection from said calling line to said trunk, a register in said trunk responsive to the dialing of the thousands digit of a wanted line designation, a sender associable with said trunk upon the seizure thereof, registers in said sender responsive to the dialing of the remaining digits of a wanted line designation, means in said trunk for determining the values of the first, second and third office code digits dialed, office code and numerical digit control registers, means responsive to said determining means for causing the operation of said office code digit control registers to register the office code digits of the wanted line designation, and means responsive to said determining means for causing the operation of said numerical digit control registers to register the numerical digits of said wanted line designation in accordance with the settings of said trunk and sender registers.

17. In a telephone system, a calling line, a trunk over which a connection may be extended to any one of a plurality of offices, a train of selector switches responsive to the dialing of one or more of the office code digits of a wanted line designation for extending a connection to said trunk, a register in said trunk responsive to the digit dialed following the seizure thereof which digit may be a second or third office code digit or a thousands numerical digit dependent on whether said trunk was seized in response to the dialing of one, two or three office code digits, a sender associable with said trunk upon the seizure thereof having a plurality of registers responsive to the dialing of the remaining digits of the wanted line designation which digits may be the last office code digit and the numerical digits, all of the numerical digits or the numerical digits following the thousands digit dependent on whether said trunk was seized in response to the dialing of one, two or three office code digits, means in said trunk for determining the values of the office code digits dialed to seize said trunk, office code digit control registers, numerical digit control registers, means responsive to said determining means for causing the operation of said office code digit control registers to register the office code digits as determined thereby or in conjunction with said trunk register and the first of said sender registers, and means for transferring the digit registrations from said trunk and sender registers in the proper order of succession to said numerical digit control registers.

18. In a telephone system, a calling line, a plurality of trunks over which a connection may be extended to any one of a plurality of offices, a train of selector switches responsive to the dialing of one or more of the office code digits of a

wanted line designation for extending a connection to an idle one of said trunks, a register in each of said trunks responsive to the digit dialed following the seizure thereof which digit may be a second or a third office code digit or a thousands numerical digit dependent upon whether said trunk was seized in response to the dialing of one, two or three office code digits, a plurality of senders, means for associating an idle one of said senders with any one of said trunks following the seizure thereof, each of said senders having a plurality of digit responsive registers for registering the remaining digits of a wanted line designation which digits may be the last office code digit and the numerical digits, all of the numerical digits or the numerical digits following the thousands digit dependent upon whether said trunk was seized in response to the dialing of one, two or three office code digits, and each of said senders having office code and numerical digit control registers, a plurality of decoders, means for associating an idle decoder with a sender following the seizure of said sender by a trunk and for associating said decoder with said trunk, means in said trunk for determining the values of the office code digits dialed to seize said trunk, means in said decoder responsive to said determining means for causing the operation of the office code digit control registers of said sender to register the office code digits as determined thereby or in conjunction with said trunk register and the first of said sender registers, and means controlled by said decoder for transferring the numerical digit registrations from said trunk and sender registers to said numerical digit control registers.

19. In a telephone system, a calling line, a plurality of trunks over which connections may be extended to any one of a plurality of offices, each of said trunks having a toll ticket printer, switching means for extending a connection from said calling line to an idle one of said trunks, a plurality of senders each having registers responsive to dialed digits and control registers, means responsive to the seizure of an idle trunk for associating an idle one of said senders therewith, a plurality of decoders each having office code digit registers and a calling line identification circuit, means responsive to the seizure of a sender for associating an idle one of said decoders with said sender, means responsive to the seizure of an idle decoder for associating it with said seized trunk, means controlled by said decoder for setting the control registers of the associated sender in accordance with the digits of the calling line identification and in accordance with the office code and numerical digits of a wanted line registered by said sender and decoder registers, means responsive to the setting of said control registers to associate said control registers with the printer of the seized trunk whereby said printer is operated to print the identification digits of said calling line and the digits of the wanted line number, and means simultaneously controlled by said sender for controlling the extension of a connection from said trunk to the wanted line whose number is registered by certain of said control registers.

20. In a telephone system, a calling line, a plurality of trunks over which connections may be extended to any one of a plurality of offices, each of said trunks having a toll ticket printer, switching means for extending a connection from

said calling line to an idle one of said trunks, a plurality of senders each having registers responsive to dialed digits and control registers, means responsive to the seizure of an idle trunk for associating an idle one of said senders therewith, a plurality of decoders each having office code digit registers and a calling line identification circuit, means responsive to the seizure of a sender for associating an idle one of said decoders with said sender, means responsive to the seizure of an idle decoder for associating it with said seized trunk, means controlled by said decoder for setting the control registers of the associated sender in accordance with the digits of the calling line identification and in accordance with the office code and numerical digits of a wanted line registered by said sender and decoder registers, means responsive to the setting of said control registers to associate said control registers with the printer of the seized trunk whereby said printer is operated to print the identification digits of said calling line and the digits of the wanted line number, means simultaneously controlled by said sender for controlling the extension of a connection from said trunk to the wanted line whose number is registered by certain of said control registers, and means in said trunk operative upon the response of the called subscriber and at intervals during the continuance of the conversation for controlling said printer to record elapsed periods of conversation.

21. In a telephone system, a calling line, a plurality of groups of trunks over which connections may be extended to any one of a plurality of offices, switching means for extending a connection from said line to an idle one of said trunks, a plurality of senders for controlling the extension of connections from said trunks, means responsive to the seizure of an idle trunk for associating an idle one of said senders therewith, a plurality of decoders, means responsive to the seizure of a sender for associating an idle one of said decoders therewith, trunk decoder-connectors for associating said decoder with said respective groups of trunks, means controlled by said trunk for registering in said decoder the group in which the seized trunk is located, and means operative in accordance with said registration for operating that one of said connectors which has access to the calling trunk group.

22. In a telephone system, a calling line, a plurality of groups of trunks over which connections may be extended to any one of a plurality of offices, switching means for extending a connection from said line to an idle one of said trunks, a plurality of senders for controlling the extension of connections from said trunks, means responsive to the seizure of an idle trunk for associating an idle one of said senders therewith, a plurality of decoders, means responsive to the seizure of a sender for associating an idle one of said decoders therewith, a decoder-connector for determining the trunk group in which said trunk is located and for connecting said decoder with said trunk, a plurality of sender-connectors common to said senders and individual respectively to said trunk groups, and means for operating that one of said sender-connectors which has access to the group in which the seized trunk is located as determined by said decoder-connector for connecting said seized sender to said trunk.