

Sept. 29, 1936.

E. D. BUTZ

2,055,652

TELEPHONE SYSTEM

Filed Oct. 4, 1934

6 Sheets-Sheet 1

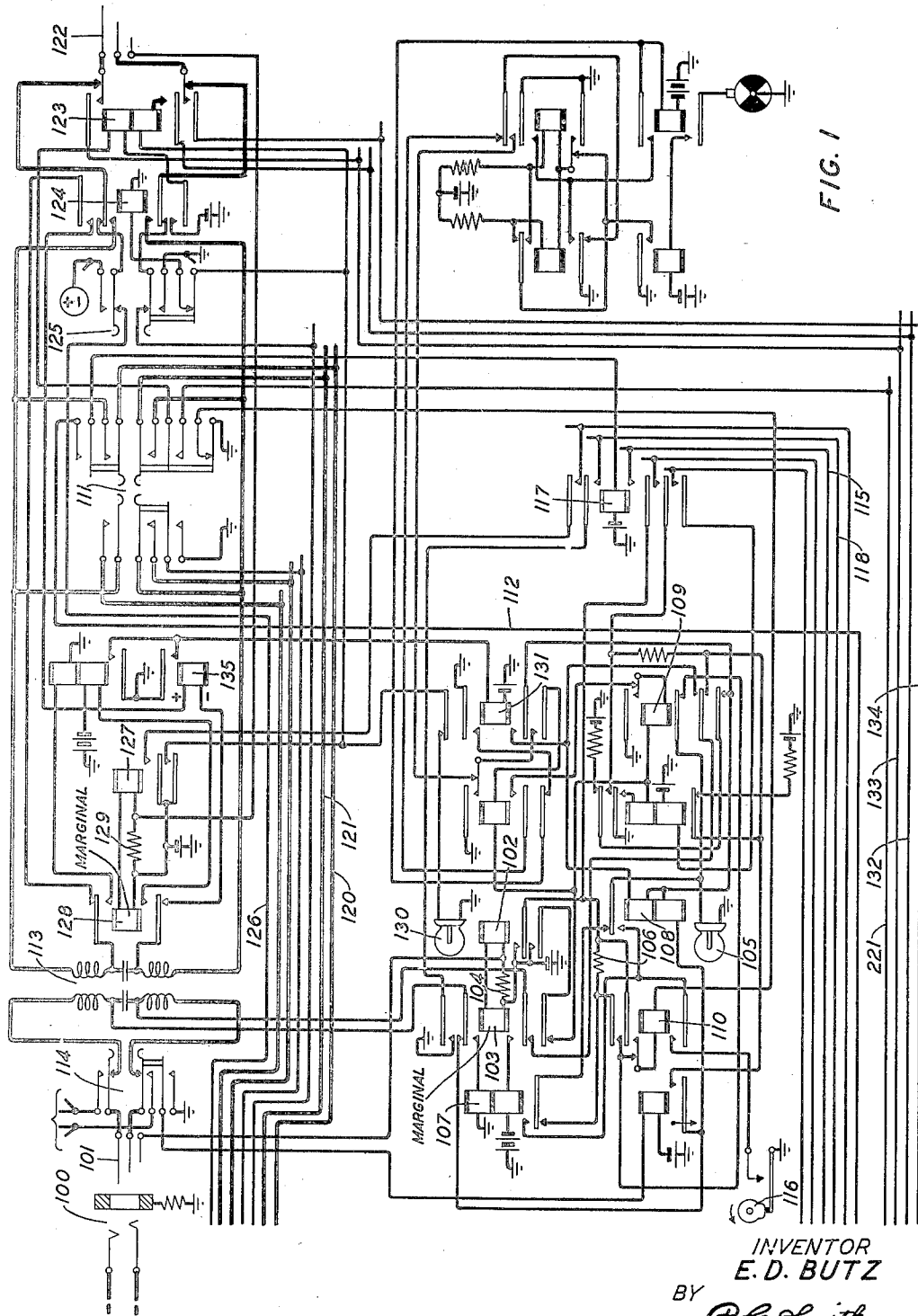


FIG. 1

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6 Sheets-Sheet 2

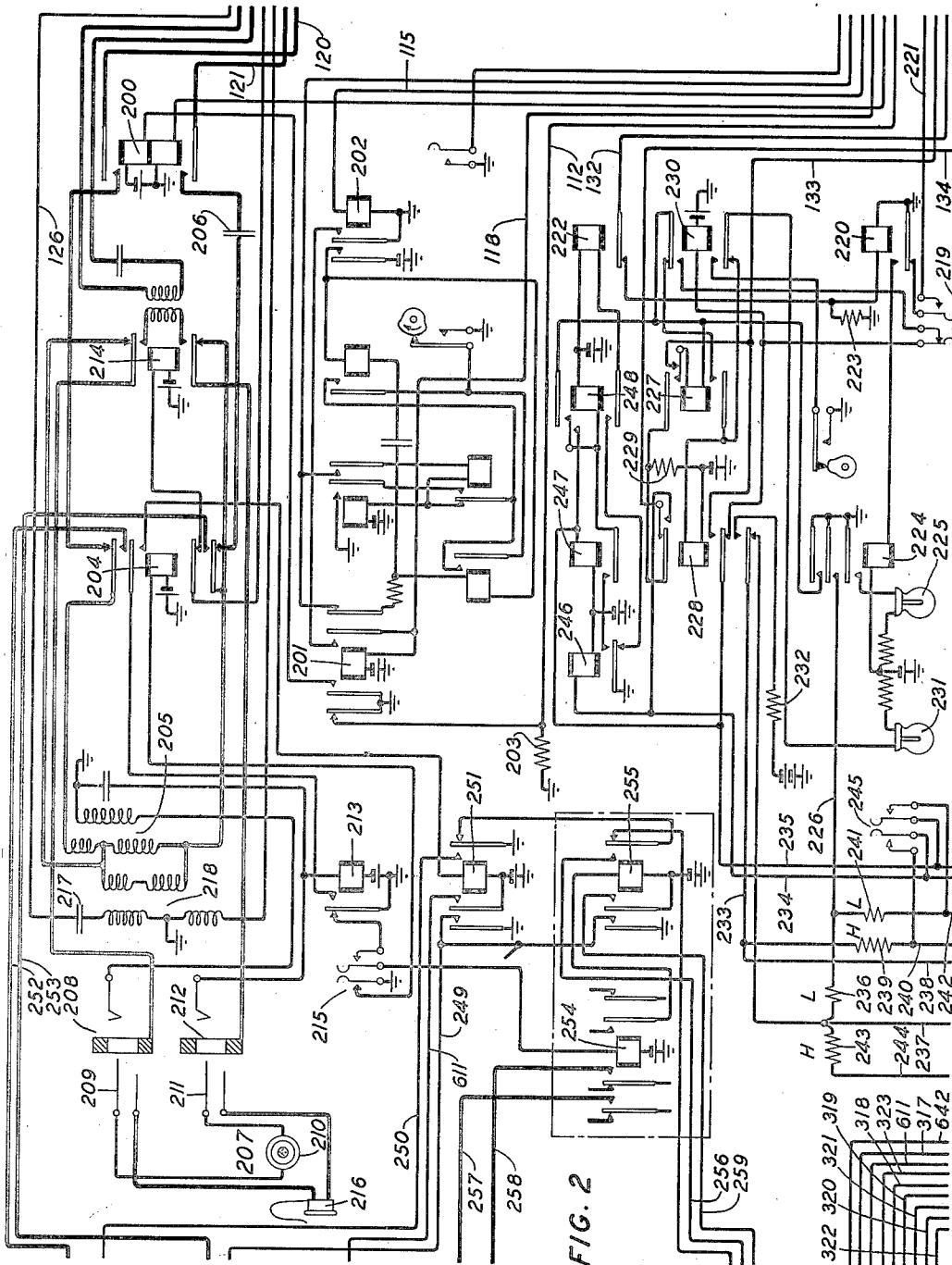


FIG. 2

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TELEPHONE SYSTEM

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6 Sheets-Sheet 3

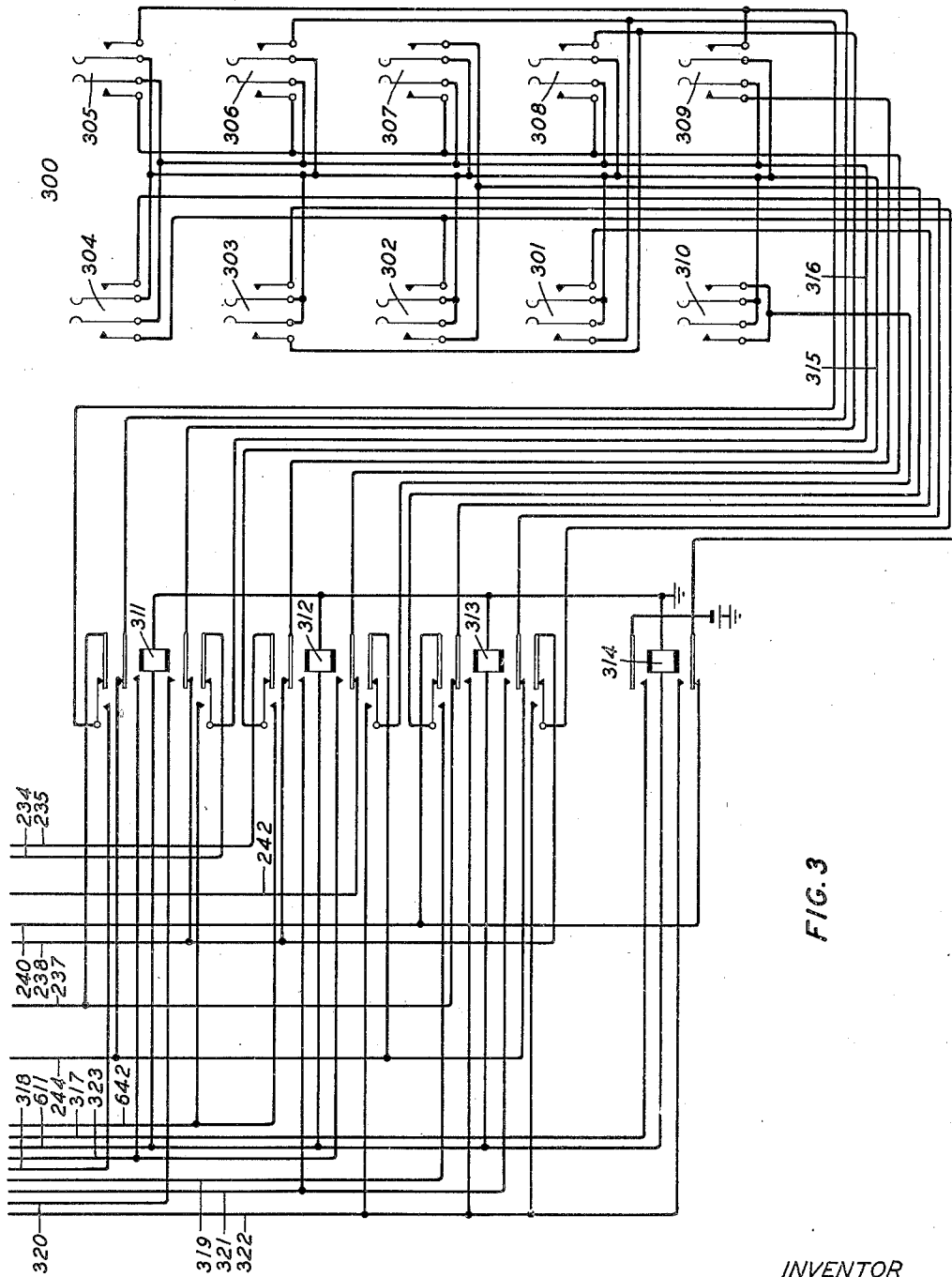


FIG. 3

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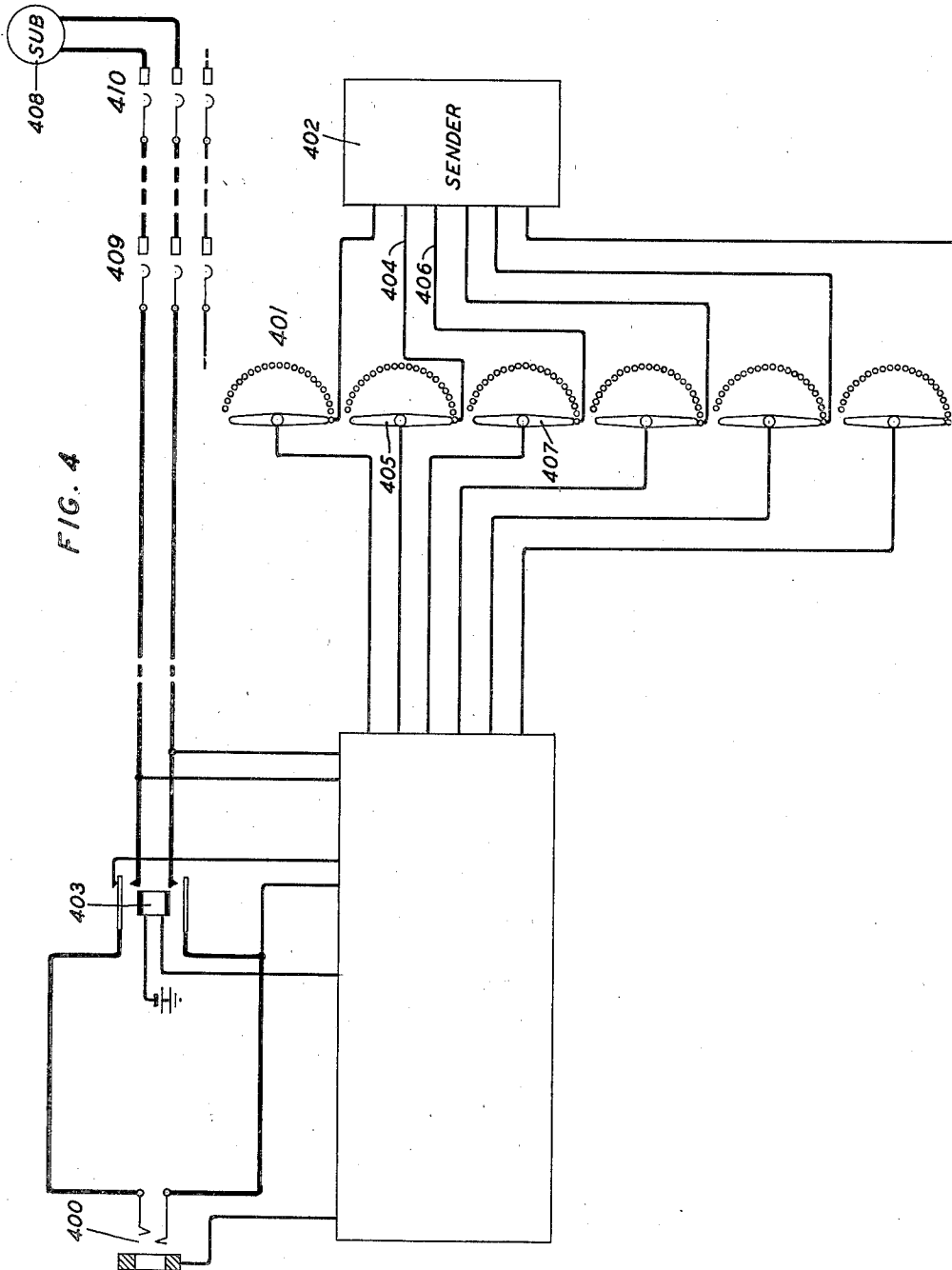
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TELEPHONE SYSTEM

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6 Sheets-Sheet 4



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TELEPHONE SYSTEM

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6 Sheets-Sheet 5

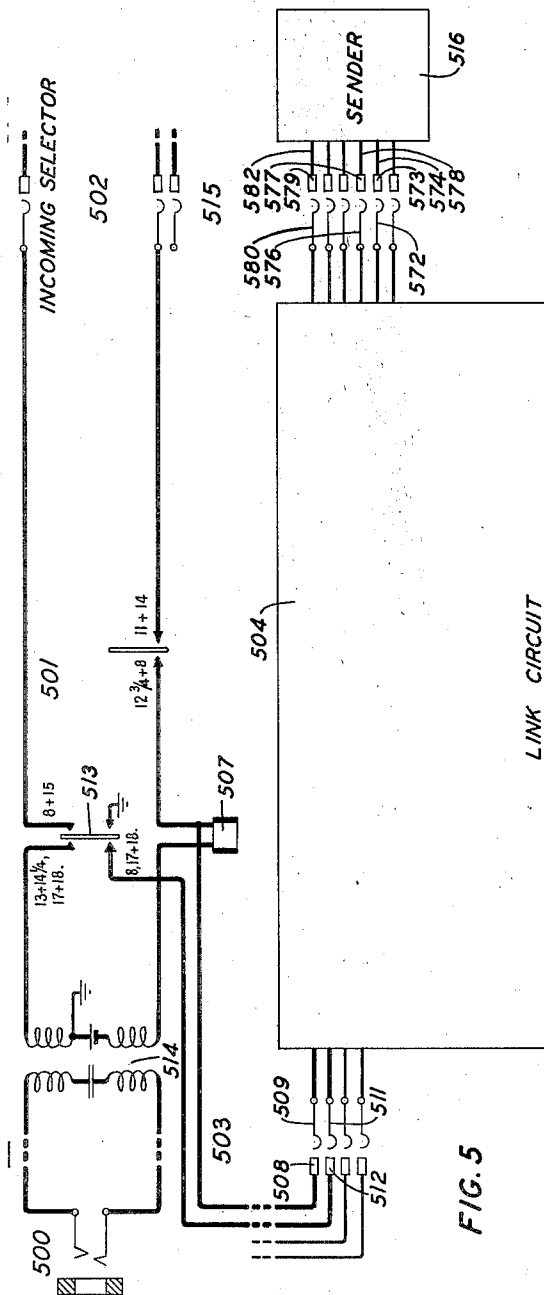
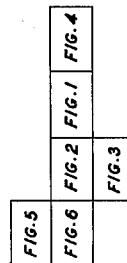


FIG. 5

FIG. 7



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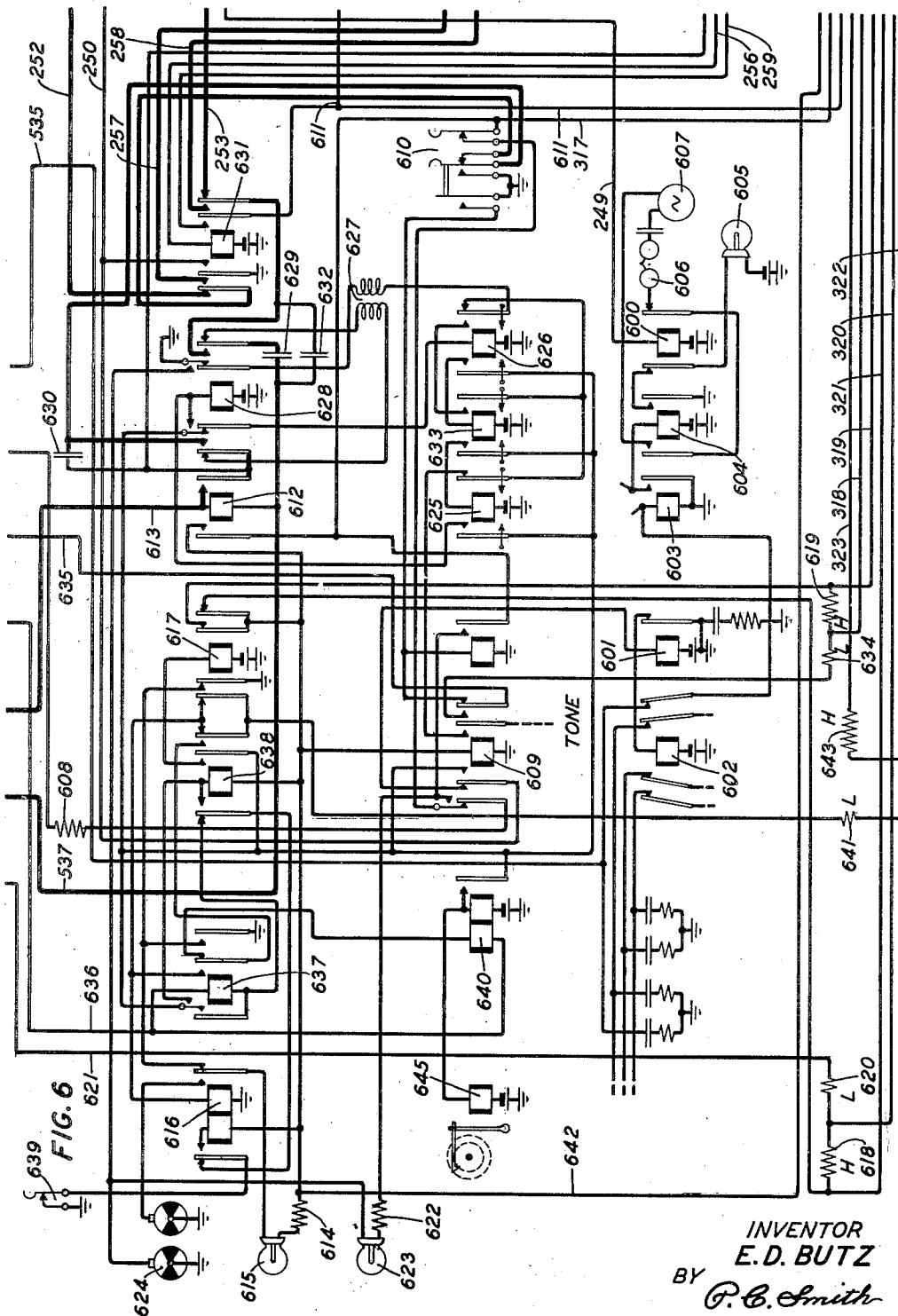
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TELEPHONE SYSTEM

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6 Sheets-Sheet 6



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UNITED STATES PATENT OFFICE

2,055,652

TELEPHONE SYSTEM

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Application October 4, 1934, Serial No. 746,793

6 Claims. (Cl. 179—27)

This invention relates to telephone exchange systems and more particularly to dial switching systems in which operators are employed for extending calls originating in manual offices of the exchange area to subscribers' lines in a dial switching office, and in which operators are also employed for giving special service to subscribers such as service on intercepted calls.

In some offices it is desirable because of economical reasons to combine some of the positions of "A" operators who attend to special service calls and some of the call distributing "B" operators' positions upon the same switchboard position. This is particularly desirable at periods when the traffic is light, as at night, when there is not sufficient traffic load to keep operators sufficiently busy. In such a combined switchboard it is possible to secure the greatest operating efficiency by enabling a "B" operator whose position is adjacent to an "A" operator's position on the same switchboard to assist in handling special service calls at such times as calls incoming to her position for termination in the dial switching equipment of the office on which she is located are few, or to permit an "A" operator whose position is adjacent to a call distributing "B" operator's position to handle special service calls on her own position and calls incoming for termination on the "B" operator's position.

It has heretofore been proposed to combine "A" and "B" positions into a combined switchboard position as disclosed, for example, in Patent No. 1,930,255 granted October 10, 1933 to G. V. Smith. As disclosed in this patent, a call distributing "B" operator's position is combined with an "A" operator's position equipped with dialing equipment. In a similar manner a call distributing "B" operator's position may be combined with an "A" operator's position equipped with key-set equipment of the type disclosed for example in Patent No. 1,897,083, granted February 14, 1933 to W. B. Strickler. When two such positions are combined into a single position, both of which have key-sets for controlling the establishment of calls which they normally handle, a saving in apparatus and in switchboard shelf space can be made by the provision of a single key-set which may be used in the establishment of either special service "A" calls or the termination of incoming "B" trunk calls. It is therefore the object of the invention to economize in the apparatus and space required for the combination of an "A" key pulsing position and call distributing "B" position upon a single switchboard position by providing a single key-set which may be made available for handling either type of call.

The key-set normally employed at a key pulsing "A" operator's position of the type disclosed in the patent to Strickler hereinbefore referred to, is designed to control the setting of the registers

of a sender associable with the operator's cord circuit, by codes of impulses transmitted over either or both of the tip and ring conductors of the operator's cord circuit and the outgoing trunk circuit to which she has connected her cord circuit, to the key pulsing type sender which is automatically connected to the trunk upon its seizure. Therefore, the key springs are so wired as to establish the proper code conditions. On the other hand, the key-set normally employed at a call distributing "B" operator's position of the type disclosed in the patent to Smith hereinbefore referred to, is designed to control the setting of the registers of a sender associable with the operator's position equipment, by codes of impulses transmitted over three conductors extending through a link circuit to the sender which has been selected by the link circuit and associated with her position, and therefore the key springs of the key-set are so wired as to establish the proper code condition on the three impulse conductors.

It thus becomes apparent that in the combination of two positions of the character set forth into a single switchboard position and the substitution of a single key-set for the two key-sets, that provision must be made for altering the wiring to the key-set springs in accordance with the type of call which is to be established from the combined position. In accordance with the present invention this is made possible by the provision of transfer relays associated with the key-set. Normally the combined position is arranged for handling special service "A" calls. The transfer relays are unoperated and the wiring to the key-set springs is such as to enable the operator to use the key-set for controlling the registration of digits in a key pulsing sender associated with her cord circuits. If, however, the operator should be required to complete an incoming "B" trunk call, the transfer relays are operated and the wiring to the key-set springs is altered to enable the operator to use the key-set for controlling the registration of digits in a call distributing "B" sender system.

The invention will be more clearly understood from a consideration of the following description taken in connection with the drawings in which:

Fig. 1 shows one of the "A" cord circuits of a combined "A" and "B" position;

Fig. 2 shows the "A" operator's telephone circuit and key pulsing control circuit and in the dot-dash rectangle a portion of an adjacent "A" operator's telephone circuit;

Fig. 3 shows the key-set circuit of the combined "A" and "B" position;

Fig. 4 shows schematically an outgoing trunk accessible to the cord circuit of Fig. 3 terminating in a selector switch having access through other 60

selector switches to a subscriber's line, a sender selector and a sender;

Fig. 5 shows schematically a trunk circuit incoming from a distant office and terminating in an incoming selector switch, a link circuit indicated by the large rectangle having a trunk finder, the brushes of which are indicated at the left; a sender selector, the brushes of which are indicated at the right and an operator's position finder, the brushes of which are indicated beneath the rectangle, and a sender indicated by the small rectangle;

Fig. 6 shows a "B" position circuit; and

Fig. 7 is a diagram showing how the several figures should be arranged to disclose the invention.

The "A" operator's telephone set, shown in Fig. 2, is normally arranged for use with cord circuits such as the one shown in Fig. 1, which the "A" operator may use to answer calls incoming from calling subscribers' lines requiring intercepted or special service. To complete such calls the operator plugs into the jack of an outgoing trunk, such as is shown in Fig. 4, whereupon the trunk is associated by a sender selector with a key pulsing sender. The operator then keys up the digits of the wanted line designation on the key-set of Fig. 3. For a detailed disclosure of the circuits schematically indicated in Fig. 4, reference may be had to the Strickler Patent 1,397,083, previously referred to. Should there be a call incoming from a distant office over an incoming trunk, such as the trunk shown in Fig. 5, which would be barred from the position as long as the "A" operator's telephone set is associated with cord circuits, the operator may by the operation of a grouping key, render her position selectable to such incoming call whereby her telephone set may be automatically connected to the incoming trunk. In completing a call of this character the operator uses the key-set of Fig. 3 to set the registers of a sender, such as is shown schematically in Fig. 5, whereupon the sender proceeds to set the incoming selector in which the incoming trunk terminates and a final selector (not shown) to select the desired line. For a complete disclosure of the sender and link circuit indicated in Fig. 5, reference may be had to the Smith Patent 1,930,255, hereinbefore referred to. The "A" operator may thus function as an "B" operator or an "A" operator, dependent upon whether terminating or local calls are incoming to her position.

Call incoming to combined position from a local office

A detailed description of the manner in which the operator normally serves as an "A" operator will first be given, it being assumed that there are no waiting "B" calls and that, therefore, grouping key 215 is normal. It will further be assumed that there is a local call on the trunk terminating in jack 100 requiring the "A" operator's attention. To answer this call she will plug the answering plug 101 of the cord circuit, shown in Fig. 1, into jack 100. A circuit is then established from ground, over the sleeves of jack 100 and plug 101 to battery through the winding of relay 102 and the winding of marginal relay 103 in series and to battery in parallel therewith through the non-inductive winding 104 of relay 103. Relays 102 and 103 both operate over a low resistance ground connected to the sleeve of trunk jack 100 and establish a circuit for supervisory lamp 105 extending from battery, inner contact

of relay 102, resistance 106, back contact of relay 107, back contact of relay 108 to ground through lamp 105 and in parallel therewith from battery over the inner contact of relay 102, resistance 106, back contact of relay 107, back contact of relay 108, inner lower back contact of relay 109, inner normal contacts and winding of relay 110 to ground at the lower right normal contacts of key 111. Relay 110 locks in a circuit from battery at the inner contact of relay 102, inner upper alternate contacts and winding of relay 110 to ground at key 111.

As soon as plug 101 is fully seated, relay 107 operates in a circuit from battery, lower winding of relay 107, lower front contact of relay 103, lower left winding of repeating coil 113, lower normal contacts of key 114, rings of plug 101 and jack 100 and returning over the tips of jack 100 and plug 101, upper contacts of key 114, upper left winding of repeating coil 113, inner upper front contact of relay 103, upper winding of relay 107 to ground. Relay 107 operates and a flashing shunt circuit is thereupon established for lamp 105 until the operator throws key 111 to the right to unlock relay 110, which circuit may be traced from ground through lamp 105, back contact of relay 108, front contact of relay 107, lower contact of relay 110 to ground at the contacts of interrupter 116. In case, however, relay 107 operates before relay 110 can operate, lamp 105 does not light. The possible flashing of lamp 105, as above described, is incidental and has no significance at this time.

When the operator throws her listening key 111 to the right or talking position, relay 110 releases and a circuit is established from ground at the outer left back contact of relay 201, conductor 112, upper right contacts of key 111 to battery through the winding of relay 117, which latter relay operates. The relay 103 operated, a circuit is now established from ground at the upper front contact of relay 103, over the inner upper front contact of relay 117, conductor 113, winding of relay 201 to battery, thus operating relay 201. Relay 117 also establishes a circuit for relay 202 extending from ground, through the winding of this relay, conductor 115, inner lower front contact of relay 117 to battery at the inner front contact of relay 102. With relay 202 operated, relay 201 locks over its right front contact to ground at the inner contact of relay 202. At its left front contact it closes an obvious circuit through the upper winding of relay 200 and at its left back contact removes direct ground from the operating circuit of relay 117. Relay 117 is, however, maintained operated over the previously traced circuit, to ground through resistance 203. Relay 117 of another cord circuit of the position will not operate in this circuit through resistance 203 in case the talking key of such cord circuit should at this time be operated to the talking position. This is for the purpose of preventing two cord circuits from being connected to the operator's telephone and key-set circuits at the same time.

With relay 200 operated a talking path is established from the upper right winding of repeating coil 113, inner upper right contacts of key 111, conductor 120, upper contact of relay 200, upper back contact of relay 204, left windings of repeating coil 205, lower back contact of relay 204, condenser 206, lower contact of relay 200, conductor 121, inner lower right contacts of key 111 to the lower right winding of repeating coil 113. Assuming that the operator's

telephone set 207 is plugged up, the transmitter of the telephone set is inductively connected to the talking path just traced over a circuit extending from ground through the right winding of repeating coil 205, tips of jack 208 and plug 209, transmitter 210, tips of plug 211 and jack 212 to battery through the winding of relay 213. Relay 213 operates in this circuit, but without effect at this time. The operator's receiver is also connected to the talking path over the lower back contact of relay 204, lower back contact of relay 214, sleeves of jack 212 and plug 211, receiver 216, sleeves of plug 209 and jack 208, upper back contact of relay 214, upper left winding of repeating coil 205, thence over the upper back contact of relay 204. The operator is thus enabled to converse with the calling subscriber to ascertain information concerning the desired connection.

It will be assumed that the desired connection is of a character which may be completed over a trunk such as is shown in Fig. 4. The operator first tests to determine if the trunk is idle or busy by touching the tip of plug 122 to the sleeve of jack 400 of the trunk. If the trunk is busy there will be battery potential on the sleeve and this potential will be transmitted over the tip of plug 122, the upper normal contacts of relay 123, the upper back contact of relay 124, the upper normal contacts of key 125, conductor 126, condenser 217 to ground through the upper left winding of repeating coil 218 which induces the busy potential through the right windings of coil 219 into the operator's receiver 216 thus producing a click. Assuming that she tests the trunk of Fig. 4 and finds that it is idle, she inserts plug 122 into jack 400 thereby establishing a circuit from ground through the winding of a trunk sleeve relay (not shown), sleeves of jack 400 and plug 122, windings of relay 127 and marginal relay 128 in series to battery and in parallel therewith through the non-inductive winding 129 of relay 128 to battery. Due to the high resistance of the sleeve relay of the trunk, marginal relay 128 does not receive sufficient current to operate, but relay 127 operates. The sleeve relay of the trunk operates and prepares the sender selector 401 to associate an idle sender with the trunk.

Relay 127 upon operating closes a circuit extending from battery over its lower contact, the lower normal contacts of key 125 to ground through the winding of relay 124 which relay operates, opening the busy test circuit at its upper back contact and at its inner upper and inner lower front contacts connects the tip and ring contacts of plug 122 to the right windings of repeating coil 113. Relay 127 at its lower contact also establishes a circuit for lamp 130 extending over the upper back contact of relay 131. Preparatory to keying the digits necessary to complete the connection, the operator now depresses key 219 and with the talking key 111 operated to the right, a circuit is established from ground at the lower back contact of relay 220, the right contacts of key 219, conductor 221, the lower intermediate contacts of key 111, the upper winding of relay 123 to battery at the lower contact of relay 124. Relay 123 thereupon operates and locks in a circuit from battery over the lower contact of relay 127, lower winding and inner front contact of relay 123, conductor 132, back contact of relay 222 and in parallel through resistance 233 and the winding of relay 220 to ground. Relay 220 operates in this circuit opening the initial operating circuit of relay 123 and

closing an obvious circuit for relay 224 which operates. Relay 123 at its upper and lower alternate contacts disconnects the tip and ring contacts of plug 122 from the right windings of repeating coil 113 and connects these contacts over conductors 133 and 134 with the operator's key-set circuit.

Relay 224 upon operating closes an obvious circuit to light lamp 225, connects ground to conductor 226 for supplying operating ground to keys of key-set 300 and establishes a circuit from ground at its upper contact through the winding and upper normal contacts of relay 227, conductor 133, upper alternate contacts of relay 123, tips of plug 122 and jack 400, upper back contact of relay 403 to battery through the winding of a relay (not shown) of the outgoing trunk. Relay 227 being marginal does not operate in this circuit, but the trunk relay operates and starts the sender finder 401 to hunt for an idle sender, for example, the sender 402. Following the seizure of the sender the tip impulsing conductor 404 is extended over brush 405 of switch 401 and thence over the upper back contact of relay 403, tips of jack 400 and plug 122, upper alternate contacts of relay 123 to conductor 133, and the ring impulsing conductor 406 is extended over brush 407, rings of jack 400 and plug 122, lower alternate contacts of relay 123, conductor 134, the upper normal contacts of relay 228, resistance 229 to battery. A relay in the sender now functions over the ring impulsing path just traced for preparing the sender to receive registrations keyed up by the operator and when thus prepared a circuit is completed over the previously traced tip impulsing path to conductor 133 and thence to ground through the winding of relay 227 for operating relay 227 as an indication that the sender is ready to receive impulses from the key-set. For a full disclosure and description of the circuits of the trunk and sender schematically shown in Fig. 4 whereby the sender is seized and prepared to receive keyed designations, reference may be had to the Strickler Patent 1,897,083 hereinbefore referred to.

Relay 227 upon operating locks over its upper alternate contacts through resistance 229 to battery, closes the circuit of relay 228 over its lower contact, the upper back contact of relay 230 to ground at the upper contact of relay 224, and closes the circuit of lamp 231 from battery through the lamp, the lower back contact of relay 230, the lower contact of relay 227, upper back contact of relay 230 to ground at the upper contact of relay 224. The lighting of lamp 231 at this time is a signal to the operator that the sender is in condition to receive and register the first digit of the desired line designation.

Relay 228 upon operating connects 48-volt battery through resistance 232 and its lower front contact to conductor 233 for supplying battery potential to key contacts of key-set 300, and connects the key-set conductors 234 and 235 over its upper alternate and inner lower front contacts to conductors 134 and 133, respectively, and thence over the circuits previously traced to the sender where such circuits terminate, respectively, in serially connected sensitive, marginal and polarized impulse responsive relays connected to 24-volt battery.

For the purpose of illustrating the manner in which key-set 300 functions for an "A" type call, it will be assumed that the operator in order to establish a connection to the line 408 shown in Fig. 4, the designation of which is a four-digit

number 1379, depresses the keys 301, 303, 307 and 309 in the order named. Upon the depression of key 301 to register the thousands digit 1, ground on conductor 226 is connected through low resistance 236, conductor 237, outer upper normal contacts of transfer relay 311, over the left contacts of key 301 and in parallel therewith over the inner upper back contact of transfer relay 313, over the right contacts of key 301, thence over conductor 315, the upper normal contacts of transfer relay 312, to conductor 235 and thence as traced over the tip impulsing conductor 404 to the sender. Due to the inclusion of low resistance 236, sufficient current flows to operate both the sensitive and marginal impulse responsive relays connected to the tip impulsing conductor 404 at the sender, but the polarized responsive relay does not receive current in the proper direction through its winding to cause its operation. Registration of the thousands digit then takes place in the sender in accordance with the operated condition of the impulse responsive relays and, upon the release of the key 301, the operated responsive relays are released and the sender is prepared to register the hundreds digit.

When the operator depresses key 303 to register the hundreds digit 3, 48-volt battery on conductor 233 through low resistance 232 is connected over conductor 238, the inner lower back contact of transfer relay 311, over the left contacts of key 303 and in parallel therewith over the lower normal contacts of transfer relay 313, the right contacts of relay 303, thence over conductor 315, the upper normal contacts of transfer relay 312 to conductor 235 and as traced to the tip responsive relays of the sender. The direction of current flowing through the windings of the tip responsive relays of the sender is such as to operate the polarized relay and since only low resistance 232 has been included in the circuit, the sensitive and marginal relays also operate. Registration of the hundreds digit then takes place in the sender in accordance with the operated condition of the impulse responsive relays and, upon the release of the key 303, the responsive relays are released and the sender is prepared to register the tens digit.

When the operator depresses key 307 to register the tens digit 7, 48-volt battery on conductor 233 through low resistance 232 is connected through high resistance 239, conductor 240, the upper normal contacts of transfer relay 313, the right contacts of key 307, conductor 315, the upper normal contacts of transfer relay 312 to conductor 235 and as traced to the tip impulse responsive relays of the sender. The direction of current flowing through the windings of these relays is such as to operate the polarized relay and since both low resistance 232 and high resistance 239 have been included in the circuit, the marginal relay does not operate, but the sensitive relay does. Key 307 also closes a circuit from ground on conductor 226 through low resistance 241, conductor 242, inner lower back contact of transfer relay 312, the left contacts of key 307, conductor 316, the lower normal contacts of transfer relay 311, conductor 234 and as traced to the ring impulse responsive relays of the sender. The current flowing over this circuit is not in the proper direction to operate the tip polarized relay, but since low resistance 241 has been included in the circuit, both the marginal and sensitive relays operate. Registration of the tens digit then takes place in

the sender in accordance with the operated condition of the impulse responsive relays and, upon the release of key 307, the operated responsive relays are released and the sender is prepared to register the units digit.

In response to the depression of key 309 for the units digit 9, 48-volt battery on conductor 233 through low resistance 232 is connected over conductor 238, the inner upper back contact of transfer relay 312, the left contacts of key 309, conductor 316, the lower normal contacts of transfer relay 311, conductor 234 and as traced to the ring impulse responsive relays of the sender. The direction of current flowing through the windings of these relays is such as to operate the polarized relay and since only the low resistance 232 has been included in the circuit both the marginal and sensitive relays operate. Key 309 also closes a circuit from ground on conductor 226 through low resistance 236, high resistance 243, conductor 244, inner upper back contact of transfer relay 311, the right contacts of key 309, conductor 315, the upper normal contacts of transfer relay 312 to conductor 235 and as traced to the tip impulse responsive relays of the sender. The direction of current flowing through the windings of these relays is not such as to operate the polarized relay and since both the low resistance 236 and the high resistance 243 have been included in the circuit, the sensitive relay operates, but the marginal relay does not. Registration of the units digit then takes place in the sender in accordance with the operated condition of the impulse responsive relays and, upon the release of the key 309 the operated responsive relays are released and the sender is prepared to register the station's letter.

Since it was assumed that the line designation keyed includes no station's letter, the operator following the keying of the line designation digits, depresses the start key 245 which at its left contacts connects 48-volt battery through low resistance 232 and high resistance 239 to conductor 234 and thence as traced through the windings of the ring impulse responsive relays of the sender. The direction of current flowing is such as to operate the polarized relay and is of sufficient strength to operate the sensitive relay, but the marginal relay does not operate. At its right contacts key 245 connects ground from conductor 226 through low resistance 241 to conductor 235 and thence as traced through the windings of the tip impulse responsive relays of the sender. The direction of current flowing over this circuit is not such as will operate the polarized relay, but since only the low resistance 241 is included in the circuit, both the sensitive and marginal relays operate. In response to the operation of the impulse responsive relays of the sender, the sender is prepared to start the selection control in accordance with the setting of its registers and 48-volt battery is connected at the sender to the impulsing circuits extending back to conductors 234 and 235 at the key-set circuit resulting in the operation of both polarized relays 246 and 247.

With relays 246 and 247 both operated, an obvious circuit is closed for relay 248 which locks to ground at the upper contact of relay 224, and connects ground over its upper contacts to conductor 235 and thence to the tip impulsing path extending to the sender. The sender thereupon opens the operating circuits through the windings of relays 246 and 247, relay 246 now releasing, but relay 247 being held operated by relay 248

248. Relay 246 upon releasing closes a circuit from ground at its back contact, lower front contact of relay 248, winding of relay 222 to battery. Relay 222 operates and opens the circuit of relay 220 which upon releasing in turn releases relay 224. Relay 224 upon releasing in turn releases relays 248, 247, 222, 227, and 228 and extinguishes lamps 225 and 231. Relay 222 upon releasing also releases relay 123 in the cord circuit. The operator's key-set circuit is now in normal condition.

The sender proceeds to control the setting of the incoming selector 409 and final selector 410. The manner in which the sender functions to register the keyed digits and to control selections in accordance therewith not being essential to an understanding of the present invention, has not been disclosed and described herein. Reference may be had to the Strickler patent heretofore referred to for a detailed description of such functions. It will be sufficient to state that when the final selector has been set upon the terminals of the wanted line 408, cut-through relay 403 of the trunk is operated and the sender is dismissed and restored to normal condition.

With relay 403 operated the talking circuit from the incoming selector 409 may be traced in part over the upper front contact of relay 403, tips of jack 400 and plug 122, upper normal contacts of relay 123, which relay released when the operator's key-set was released following the completion of keying, inner upper front contact of relay 124, upper right winding of repeating coil 113, upper back contact of relay 128, upper front contact of relay 124, winding of polarized supervisory relay 135, lower back contact of relay 128, lower right winding of repeating coil 113, inner lower front contact of relay 124, lower normal contacts of relay 123, rings of plug 122 and jack 400, lower front contact of relay 403, thence to the incoming selector. When the called subscriber answers, current flowing over this talking path is reversed in the well known manner thereby causing the operation of polarized relay 135 of the cord circuit. Relay 135 causes the operation of relay 131 over an obvious circuit, which in turn, at its upper back contact, opens the circuit of calling supervisory lamp 130.

Upon the termination of the conversation, the calling and called subscribers restore their receivers to their respective switchhooks thereby releasing the answering supervisory relay 107 and the calling supervisory relay 135 whereupon lamps 105 and 130 light as disconnect signals. The operator upon noting the lighted lamps withdraws the plugs 101 and 122 releasing the operated relays in the cord circuit, extinguishing lamps 105 and 130 and opening the talking circuit to the incoming selector 409. The incoming selector 409 and final selector 410 now restore in the well known manner. The withdrawal of plug 122 from jack 400 also causes the restoration of apparatus of the outgoing trunk.

Trunk call incoming to combined position from a distant office

When a distant "A" operator has received a desired line number from a calling subscriber, she calls upon a "B" operator for assistance in completing the connection. She does this by inserting the calling plug of her cord circuit into a jack individual to a trunk which terminates in an incoming selector controlled by the "B" position equipment. It will be assumed that the distant "A" operator inserts the plug of her cord

circuit into jack 500 of trunk 501 terminating in incoming selector 502 and thereby causes the trunk finder 503 of the link circuit 504 to operate to associate the link circuit with the trunk. It will be further assumed that all regular "B" operators' positions are vacant and that the operator of the combined "A" and "B" position is at the time functioning as an "A" operator and that consequently key 215 is in its normal position.

Relays 600 to 604, inclusive, are relays of the night alarm circuit common to all "B" positions of the office. With the combined position thus functioning normally as an "A" position and key 215 normal, there will be no ground on conductor 249 and relay 600 will be unoperated. There will also be no ground on conductor 250 and relay 601 will be unoperated and consequently relay 602 will be operated. When therefore the link circuit 504 is seized, battery through a relay (not shown) in the link circuit will be connected to conductor 535 and a circuit will thus be completed over a front contact of relay 602 to ground through the winding of relay 603. The relay in the link circuit functions to prevent the hunting operation of the position finder 510 and relay 603 operates to close an obvious circuit for relay 604 which, in turn, closes a circuit for call awaiting lamp 605 extending from battery through lamp 605, left back contact of relay 600 to ground at the right front contact of relay 604 and a circuit for night alarm bell 606 extending over the right back contact of relay 600, left front contact of relay 604 through ringing generator 607.

The "A" operator at the combined position upon hearing the night alarm bell 606 and seeing the position lamp 605 lighted depresses the key 215 thereby closing an obvious circuit for relay 204 which, in turn, establishes a circuit extending from battery, winding of relay 251, inner upper front contact of relay 204 to ground at the front contact of relay 213, and transfers the operator's head-set receiver 216 from the talking conductors 120 and 121 extending to her "A" cord circuits to the talking conductors 252 and 253 extending to the "B" position circuit of Fig. 6. The operation of relay 251 also connects ground to conductors 249 and 250 operating relays 600 and 601. Relay 600 upon operating extinguishes lamp 605 and silences the alarm bell 606, and relay 601 upon operating releases relay 602 which, in turn, releases relays 603 and 604 and the aforementioned relay of the link circuit 504. Relay 251 also closes a circuit from battery at its inner left front contact over conductor 611, through the windings of transfer relays 311, 312, 313, and 314 in parallel to ground thereby operating the transfer relays.

Assuming that the position finder 510 is standing with its brushes on the terminals of a vacant "B" position circuit, the position finder 510 will be started in a hunting movement by the release of the above mentioned link circuit relay. When the test brush 524 thereof engages the test terminal of the position circuit of Fig. 6 a circuit will be closed thereover through resistance 608, outer left normal contacts of relay 609, right normal contacts of key 610, conductor 317 to battery at the upper contact of transfer relay 314. A relay in the link circuit operates over this circuit to arrest the brushes of the position finder 510 on the terminals of the position circuit of Fig. 6 and for advancing the link circuit sequence switch. A circuit is now closed from battery through the lower right winding of repeating

coil 514, winding of supervisory relay 507, terminal 508 and brush 509 of the trunk finder 503 through the link circuit to brush 505 of the position finder, conductor 537, winding of relay 612, brush 511 and terminal 512 of the trunk finder 503, left contacts of sequence switch cam 513 to ground through the upper right winding of repeating coil 514. Relay 612 operates over this circuit and closes a circuit from battery on conductor 317, left contact of relay 612, resistance 614, white-capped lamp 615, right back contact of relay 616 to ground at the inner left back contact of relay 617, connects battery over its left front contact, the right back contacts of relay 617 to the key-set circuit of Fig. 3 either directly or through resistances 618 and 619 and to conductor 621 through low resistance 620 and high resistance 618, and through the winding of relay 609. Lamp 615 lights and relay 609 operates.

Relay 609 upon operating opens the circuit previously traced over brush 524 for further advancing the link circuit sequence switch and connects battery through resistances 619 and 634, outer right front contact of relay 609 to conductor 635, establishes a circuit from battery on conductor 317 over the right normal contacts of key 610, outer left alternate contacts of relay 609, resistance 622, green-capped lamp 623 to ground through interrupter 624 for flashing lamp 623, and establishes a circuit from a source of tone current over the inner right front contact of relay 609, the back contact of relay 625, back contact of relay 626, right winding of tone coil 627, to ground at the inner right normal contacts of relay 628. This causes a tone current to be induced into the left winding of coil 627 which is connected from conductor 513 over the right front contact of relay 612, outer left back contact of relay 628, left winding of coil 627, outer right back contact of relay 628, condenser 629 to conductor 537. The tone current thus flows over the previously traced circuit through the right windings of repeating coil 514 of trunk 501 and is induced through the left windings of this repeating coil over the circuit extending to the distant "A" operator's position and to her head-set. A part of this tone current also flows in a parallel circuit through condenser 630, the intermediate normal contacts of key 610, the outer left back contact of relay 631, conductor 252, upper front contact of relay 204, upper left winding of repeating coil 205, upper back contact of relay 214, sleeves of jack 208 and plug 209, the "A" operator's head-set receiver 216, sleeves of plug 211 and jack 212, lower back contact of relay 214, outer lower front contact of relay 204, conductor 253, outer right back contact of relay 631, through condenser 632. Both the distant "A" operator and the "A" operator of the combined position hear this tone.

Relay 609 also closes a circuit extending from battery through the winding of slow-to-operate relay 626, inner left normal contacts of relay 623, inner left front contact of relay 609 to ground on conductor 250. As soon as relay 626 operates it opens the circuit through the right winding of tone coil 627 to discontinue the tone and closes a circuit from battery through the winding of slow-to-operate relay 633, left contact of relay 626, inner left front contact of relay 609 to ground on conductor 250. With relays 626 and 633 both operated the circuit through the right winding of tone coil 627 is again established and

a second tone signal is transmitted to the distant "A" and the local "A" operators' head-set receivers. Relay 633 also closes a circuit from battery through the winding of slow-to-operate relay 625, left contact of relay 633, inner left front contact of relay 609 to ground on conductor 250 and after an interval relay 625 operates again opening the circuit through the right winding of tone coil 627 to discontinue the second tone signal. At its left contact relay 625 establishes a circuit from battery, winding of relay 628, left contact of relay 625, inner left front contact of relay 609 to ground on conductor 250. Relay 628 operates locking over its inner left alternate contacts and the inner left front contact of relay 609 to ground on conductor 250, opening the circuit through both windings of tone coil 627 and closing a talking circuit extending from conductor 613, right front contact of relay 612, outer left front contact of relay 623, thence as traced to the local "A" operator's head-set receiver 216, returning over the outer right front contact of relay 623, condenser 629 to conductor 537. The distant "A" operator may now converse with the local "A" operator to pass the designation of the desired connection, the distant "A" operator having been informed by the two tones or "zip" signals that the local "A" operator is ready to receive such information.

Relay 628 upon operating also connects steady ground to the circuit of lamp 623 over its inner right alternate contacts so that lamp 623 now glows steadily, and opens the circuit of relay 626 which now releases in turn releasing relays 633 and 625. The steady glowing of lamps 615 and 623 is an indication to the local "A" operator that the number may be passed to her.

In the meantime the link circuit 504 has proceeded to cause the sender selector 515 to hunt for and associate an idle sender with the position circuit of Fig. 6. It will be assumed that the sender selector 515 has found the sender 516 idle. It will be recalled that battery was connected at the position circuit of Fig. 6 to conductors 621 and 635. Conductor 621 is now extended over brush 553 through the link circuit, brush 572 and terminal 573 of the sender selector, conductor 574, to ground through the windings of relays, (not shown), in the sender, and conductor 635 is extended over brush 557 through the link circuit, brush 576 and terminal 577, conductor 578 to ground through the winding of another relay (not shown) in the sender. A circuit is thereby rendered effective from battery in the sender over conductor 582, terminal 579 and brush 580 of sender selector 515, thence through the link circuit over brush 559, conductor 636, winding of relay 637, left back contact of relay 638, right back contact of relay 616 to ground at release key 639. Relay 637 operates, locks over its outer left front contact, the inner left front contact of relay 609 to ground on conductor 250, and closes a circuit for relay 633 extending from battery on conductor 317, left contact of relay 612, winding of relay 638, left front contacts of relay 637, thence to ground as traced on conductor 250. Relay 638 upon operating locks over its left front contact and the left back contact of relay 616 to ground at key 639, extends ground on conductor 250 over the inner left front contact of relay 609, its own inner right front contact to battery through the winding of relay 617, and at its left back contact opens the initial operating circuit of relay 637. Relay 617 upon operating opens its

right contacts thereby disconnecting battery from conductors 621 and 635 releasing the aforementioned relays of the sender whereby the circuit previously traced through the winding of relay 637 at the position circuit is opened.

Relay 637 upon releasing connects conductor 636 through the left winding of relay 640, inner right back contact of relay 637, outer right front contact of relay 638, resistance 641 to the key-set circuit of Fig. 3 and extinguishes the white-capped lamp 615, which was maintained lighted over the outer right front contact of relay 637 after the operation of relay 617, as a signal that the sender 516 is attached and ready to receive digits of a desired line designation. For the purpose of more readily identifying the registration control circuits extending from the operator's key-set 300 to the sender, the first of these circuits, which will be hereinafter referred to as the No. 1 circuit, extends from resistances 619 and 634 at the position circuit over the outer right front contact of relay 609, conductor 635, thence as traced to conductor 578 in the sender. The second circuit, which will be hereinafter referred to as the No. 2 circuit, extends from resistances 618 and 620 over conductor 621, thence as previously traced to conductor 574 in the sender, and the third circuit, which will be hereinafter referred to as the No. 3 circuit, is established from resistance 641, outer right front contact of relay 638, right back contact of relay 637, left winding of relay 640, conductor 636, thence as previously traced to conductor 582 in the sender.

At the position circuit the No. 1 circuit may be extended through low resistance 634, conductor 318, the upper alternate contacts of transfer relay 311, the left contacts of the No. 1 key 301 or the right contacts of the No. 6 key 306, conductor 315, the upper alternate contact of transfer relay 312, to conductor 642, which is connected to battery on conductor 317 over the left contact of relay 612, or through low resistance 634 and high resistance 619, conductor 319, the upper alternate contacts of transfer relay 313, the left contacts of the No. 2 key 302 or the right contacts of the No. 7 key 307, conductor 315, the upper alternate contacts of transfer relay 312, to battery on conductor 642. Circuit No. 2 may be extended through low resistance 620, conductor 320, the inner lower front contact of transfer relay 311, the left contacts of the No. 3 key 303, or the right contacts of the No. 8 key 308, conductor 315, thence as traced to battery on conductor 642, or through the low resistance 620 and high resistance 618, conductor 321, the inner lower front contact of transfer relay 313, the right contacts of No. 4 key 304, conductor 315 thence as traced to battery on conductor 642, or over the inner upper front contact of transfer relay 312, the left contacts of the No. 9 key 309, conductor 316, lower alternate contacts of transfer relay 311, to battery on conductor 642. Circuit No. 3 may be extended through low resistance 641, conductor 322, over the lower alternate contacts of transfer relay 312, the contacts of the No. 0 key 310, conductor 315, thence as traced to battery on conductor 642, or from conductor 322 over the inner upper front contact of transfer relay 313, the right contacts of the No. 1 key 301, conductor 315 and thence to battery on conductor 642, or from conductor 322 over the lower front contact of transfer relay 314, right contacts of the No. 2 key 302, conductor 315, thence to battery on conductor 642, or from conductor 322 over the lower alternate contacts of transfer relay 313, right

contacts of the No. 3 key 303, conductor 315, thence to battery on conductor 642 or from conductor 322 over the lower front contact of transfer relay 314, left contacts of the No. 4 key 304, conductor 316 thence to battery on conductor 642. Circuit No. 3 may also be extended through low resistance 641 and high resistance 643, conductor 323, inner lower front contact of transfer relay 312, left contacts of the Nos. 5 to 8 keys 305, 306, 307 or 308, conductor 316, lower alternate contacts of transfer relay 311 to battery on conductor 642, or from conductor 323, inner upper front contact of transfer relay 311, right contacts of the No. 9 key 309, conductor 315 thence to battery on conductor 642. From a consideration of the circuits traced above it will be apparent that circuit No. 3 is completed whenever any key is depressed and that either circuit No. 1 or No. 2 or neither will be completed by the operation of any key but not both.

Inasmuch as the present invention is concerned only with the keying of the proper code combinations for setting the registers of a sender, it has not been considered necessary to disclose or describe in detail the circuits of the sender whereby the registrations in the sender of keyed digits is controlled over the three control circuits previously traced. Reference is therefore made to the Smith patent hereinbefore noted for a complete disclosure of the sender and for a detailed description of the manner in which the sender functions to register keyed digits and to control the setting of selector switches in accordance with such registrations.

Assuming for the purposes of illustration that the subscriber's line to which the subscriber in the distant office has requested a connection has the designation 3456, the operator will successfully operate the Nos. 3, 4, 5, and 6 keys 303, 304, 305 and 306. Considering the three registration control circuits above traced it will be recalled that the operation of the No. 3 key completes the No. 2 and No. 3 control circuits from battery on conductor 642 through low resistances 620 and 641 respectively. The completion of the No. 3 circuit operates relay 640 which locks over its right winding and front contact to ground on conductor 250. Relay 640 in operating extends the circuit of peg count meter 645 to the locking ground of relay 640. Since circuit No. 3 is completed no matter which key is operated, and relay 640 locks as soon as operated, it will be apparent that the depression of any key by the operator in the setting up of a call will cause the peg count meter 645 to register once.

The depression of the No. 4 key extends circuit No. 2 from battery on conductor 642 through high resistance 618 and low resistance 620 and extends the No. 3 circuit from battery on conductor 642 through low resistance 641. The depression of the No. 5 key completes circuit No. 3 through both high resistance 643 and low resistance 641 to battery on conductor 642 but completes neither the No. 1 or No. 2 circuit. The depression of key No. 6 completes the No. 3 circuit from battery on conductor 642 through both high resistance 643 and low resistance 641 and the No. 1 circuit from battery on conductor 642 through low resistance 634.

If the operator depresses a wrong key and realizes it before she has depressed the last key to register the last digit of the designation, she may release the sender by operating key 639. By doing so she releases relay 638 which in turn releases relay 617. Relay 617 upon releasing lights

lamp 615 and again connects battery to the No. 1 and No. 2 control circuits thereby causing the operated register relays of the sender to release. When the key 639 is released the position and sender circuits function to prepare themselves for the registration of the correct number which the operator then keys.

When the key of the key-set upon which the last digit of the designation is keyed is released, the sender functions to advance the link circuit sequence switch and to advance the sequence switch of the incoming selector 502 from position 18 into position 1. The incoming selector and sender are now in condition for making fundamental selections. The link circuit also causes the release of relay 612 of the position circuit which in turn releases relays 609, 617, 628, 638 and 643 and extinguishes lamps 615 and 623 thereby freeing the position circuit to receive another call.

The sender then proceeds to set the incoming selector 502 and the final selector (not shown) to extend the connection to the subscriber's line whose designation 3456 was registered in the sender. When the connection is completed and the called subscriber has answered, the distant "A" operator is given a supervisory signal. The sender after completing its functions advances the link circuit which then causes the restoration of the trunk finder 503 and the sender selector 515 to normal, thus dismissing the sender 516. A talking circuit now extends from the distant calling line over the distant "A" operator's cord circuit, trunk 501, incoming selector 502 and final selector to the called subscriber's line and all other apparatus employed in the establishment of the connection is in normal condition. When the established connection is no longer needed the distant "A" operator removes her cord plug from jack 500 of trunk 501 thereby initiating the restoration of incoming selector 502 which in turn causes the restoration of the final selector.

Incoming trunk call handled by adjacent "A" operator

It will now be assumed that when a call from the distant "A" position is initiated over the incoming selector trunk of Fig. 5 and the link circuit of Fig. 5 has functioned to connect with the calling trunk, that all "B" positions and the combined "A" and "B" position are vacant as signified by the removal of the head-set plug from the jacks of those positions, but that an "A" position adjacent to the combined "A" and "B" position on the same switchboard is occupied. It will also be assumed that the key 215 is in normal position and that therefore there is no ground present on conductors 249 and 250. When, therefore, in response to the incoming call, battery is connected to conductor 535, relay 603 operates in turn operating relay 604 which causes the illumination of position lamp 605, the ringing of night alarm bell 606, and the functioning of the link circuit 504 to prevent the position finder 510 from seizing a "B" position circuit.

An "A" operator's position which is adjacent to the combined "A" and "B" position on the same switchboard is illustrated schematically by the dot and dash rectangle in the lower portion of Fig. 2. This position is similar to the position shown in detail in the remaining portion of Fig. 2, only relays 254 and 255 thereof corresponding to relays 204 and 251 respectively being shown. Normally this position functions as an "A" posi-

tion and therefore relays 254 and 255 are in normal condition and the operator's head-set is connected over the back contacts of relay 254 to the talking conductors, corresponding to conductors 120 and 121, extending to the cord circuits of such position.

At night, however, this adjacent "A" operator may in addition to handling her regulator calls handle calls intended to be handled by "B" operators. If such a "B" call comes in at night when all the "B" positions are vacant and the combined "A" and "B" position is also vacant and the night alarm bell 606 rings, she may reach over to the adjacent combined "A" and "B" position and depress key 215 thereby closing the circuit of relay 204, but as relay 213 is not operated, the combined "A" and "B" position being vacant, the circuit of relay 251 is not completed but a circuit is completed for relay 254 of the adjacent "A" position. This circuit extends from ground over the back contact of relay 213, right contacts of key 215 to battery through the winding of relay 254. With the position relay corresponding to relay 213 operated, a circuit is now established from ground at the front contact of this relay, right front contact of relay 254 to battery through the winding of relay 255. Since relay 251 is not operated and relay 255 is operated, a circuit is established from ground at the back contact of relay 251, right front contact of relay 255, conductor 256 to battery through the winding of grouping relay 631.

Relay 254 upon operating also transfers the "A" operator's head-set receiver from the talking conductors extending to her cord circuits, to the talking conductors 257 and 258 extending to the "B" position circuit of Fig. 6. Relay 255 upon operating connects ground to conductor 249 thereby operating relay 600, and relay 631 connects ground directly to conductor 250 for operating relay 601 and extends conductor 611 over its inner right front contact, conductor 259, inner left front contact of relay 255 to battery whereby key-set transfer relays 311 to 314 of the adjacent combined "A" and "B" position are operated. In the manner previously described relay 600 upon operating extinguishes lamp 605 and silences the alarm bell 606 and relay 601 releases relays 603 and 604 and permits the link circuit to function to cause the position finder 510 to select the position circuit of Fig. 6. This position circuit is now marked as available by battery connected through the operation of transfer relay 314, over conductor 317, the right normal contacts of key 610, the outer left normal contact of relay 609, resistance 608 to the test terminal to which test brush 524 of position finder 510 has access. As soon as the position is found, relay 612 operates following which two "zip" tones are transmitted to the originating operator in the manner previously described, a portion of these tones being transmitted to the answering "A" operator's receiver through condenser 630, the intermediate normal contacts of key 610, the outer left front contact of grouping relay 631, conductor 257, the outer left front contact of relay 254, thence through the operator's receiver returning over the inner left front contact of relay 254, conductor 258, outer right front contact of grouping relay 631 to condenser 632. The answering "A" operator hears the tone. Following the transmission of the tone signals, relay 628 operates as previously described to discontinue the application of tone current and to establish a talking circuit between the operators over which the

answering "A" operator may receive instructions from the originating "A" operator as to the designation of the desired connection.

As previously described, the link circuit proceeds to connect with an idle sender and following which connection lamp 615 is extinguished as a signal that the sender is ready to register the designation of the desired connection. The answering "A" operator perceiving that the lamp 215 is extinguished then reaches over to the adjacent combined "A" and "B" position and manipulates the keys of the key-set 300 in accordance with the designation which she has received from the originating "A" operator. The circuits then function in exactly the same manner as previously described.

From the foregoing description it will be apparent that provision has been made for enabling an "A" operator at one position of an "A" switchboard to function normally as an "A" operator and at periods of light traffic to function either as an "A" or "B" operator and for enabling another "A" operator whose position is adjacent to function both as an "A" or "B" operator and that the efficiency of this provision is increased by the employment of a single key-set for the combined position which may be used by the "A" operator at the combined position or by an "A" operator whose position is adjacent thereto for controlling either the completion of incoming "A" or "B" type calls.

What is claimed is:

1. In a telephone system, an operator's position, cord circuits, trucks accessible thereto and terminating in selector switches, register senders of a first group for controlling said switches and associable with said operator's position, the registers thereof being settable in accordance with certain digit codes, incoming trunks terminating in selector switches, register senders of a second group for controlling said latter switches and associable with said operator's position, the registers thereof being settable in accordance with other digit codes, and a key-set at said position for controlling the transmission of either type of digit codes for setting the registers of a sender of either group.

2. In a telephone system, an operator's position, cord circuits, trunk circuits accessible thereto and terminating in selector switches, register senders of a first group for controlling said switches and associable with said operator's position, the registers thereof being settable in accordance with certain digit codes, incoming trunks terminating in selector switches, register senders of a second group for controlling said latter switches and associable with said operator's position, the registers thereof being settable in accordance with other digit codes, a key-set at said position, and means for enabling said key-set to control the transmission of either type of digit codes for setting the registers of a sender of either group.

3. In a telephone system, an operator's position, cord circuits, trunk circuits accessible thereto and terminating in selector switches, register senders of a first group for controlling said switches and associable with said operator's position, the registers thereof being settable in accordance with certain digit codes, incoming trunks terminating in selector switches, register senders of a second group for controlling said latter switches and associable with said operator's position, the registers thereof being settable

in accordance with other digit codes, a key-set at said operator's position, and transfer relays for altering the connection to the keys of said key-set to enable said key-set to control the transmission of either type of digit codes for setting the registers of a sender of either group.

4. In a telephone system, an operator's position, cord circuits, trunks accessible thereto and terminating in selector switches, register senders of a first group for controlling said switches and associable with said operator's position, the registers thereof being settable in accordance with certain digit codes, incoming trunks terminating in selector switches, register senders of a second group for controlling said latter switches and associable with said operator's position, the registers thereof being settable in accordance with other digit codes, a key-set at said position normally conditioned to control the transmission of said certain digit codes for setting the registers of a sender of the first group, and means operable to alter the condition of said key-set for controlling the transmission of said other digit codes for setting the registers of a sender of the second group.

5. In a telephone system, an operator's position, cord circuits, trunk circuits accessible thereto and terminating in selector switches, register senders of a first group for controlling said switches and associable with said operator's position, the registers thereof being settable in accordance with certain digit codes, incoming trunks terminating in selector switches, register senders of a second group for controlling said latter switches and associable with said operator's position, the registers thereof being settable in accordance with other digit codes, a key-set at said operator's position normally conditioned to control the transmission of said certain digit codes for setting the registers of a sender of the first group, and transfer relays operable at the will of the operator to alter the condition of said key-set for controlling the transmission of said other digit codes for setting the registers of a sender of the second group.

6. In a telephone system, an operator's position having a telephone set and a key-set, cord circuits, trunks accessible to said cord circuits and terminating in selector switches, register senders of a first group for controlling said switches, the registers thereof being settable in accordance with certain digit codes, talking conductors for normally rendering said telephone set associable with said cord circuits, means for associating any one of said senders with said key-set, said key-set being normally conditioned to control the transmission of said certain digit codes to set the registers of the associated sender, incoming trunks terminating in selector switches, register senders of a second group, the registers thereof being settable in accordance with other digit codes, switching mechanism for interconnecting any one of said latter trunks, any one of said latter senders and said operator's position but barred from connecting one of said latter trunks to the position when said telephone set is associated with said conductors, means for disassociating said telephone set from said conductors, and means controlled by said latter means for altering the condition of said key-set for controlling the transmission of said other digit codes for setting the registers of a sender of the second group.

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