

Oct. 10, 1944.

P. W. WADSWORTH

2,360,291

TELEPHONE SYSTEM

Filed March 20, 1941

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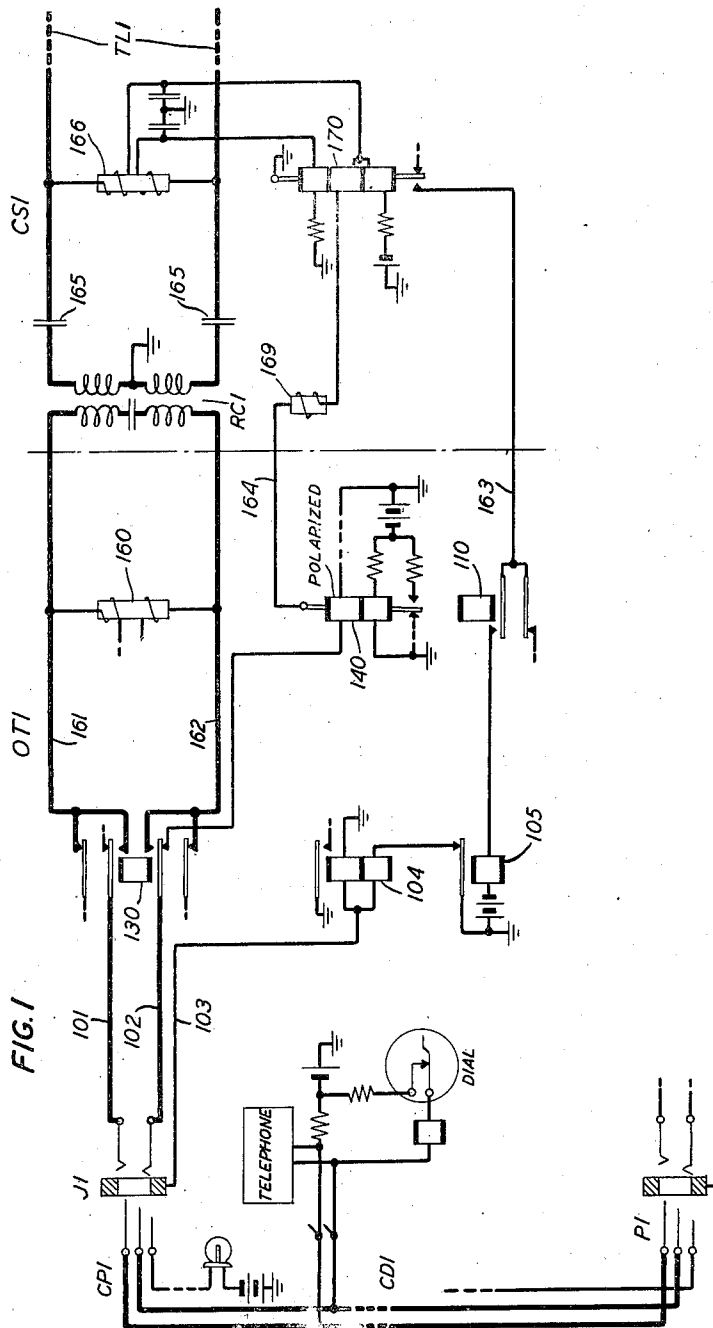


FIG. 6

FIG. 1	FIG. 2	FIG. 3	FIG. 4	FIG. 5
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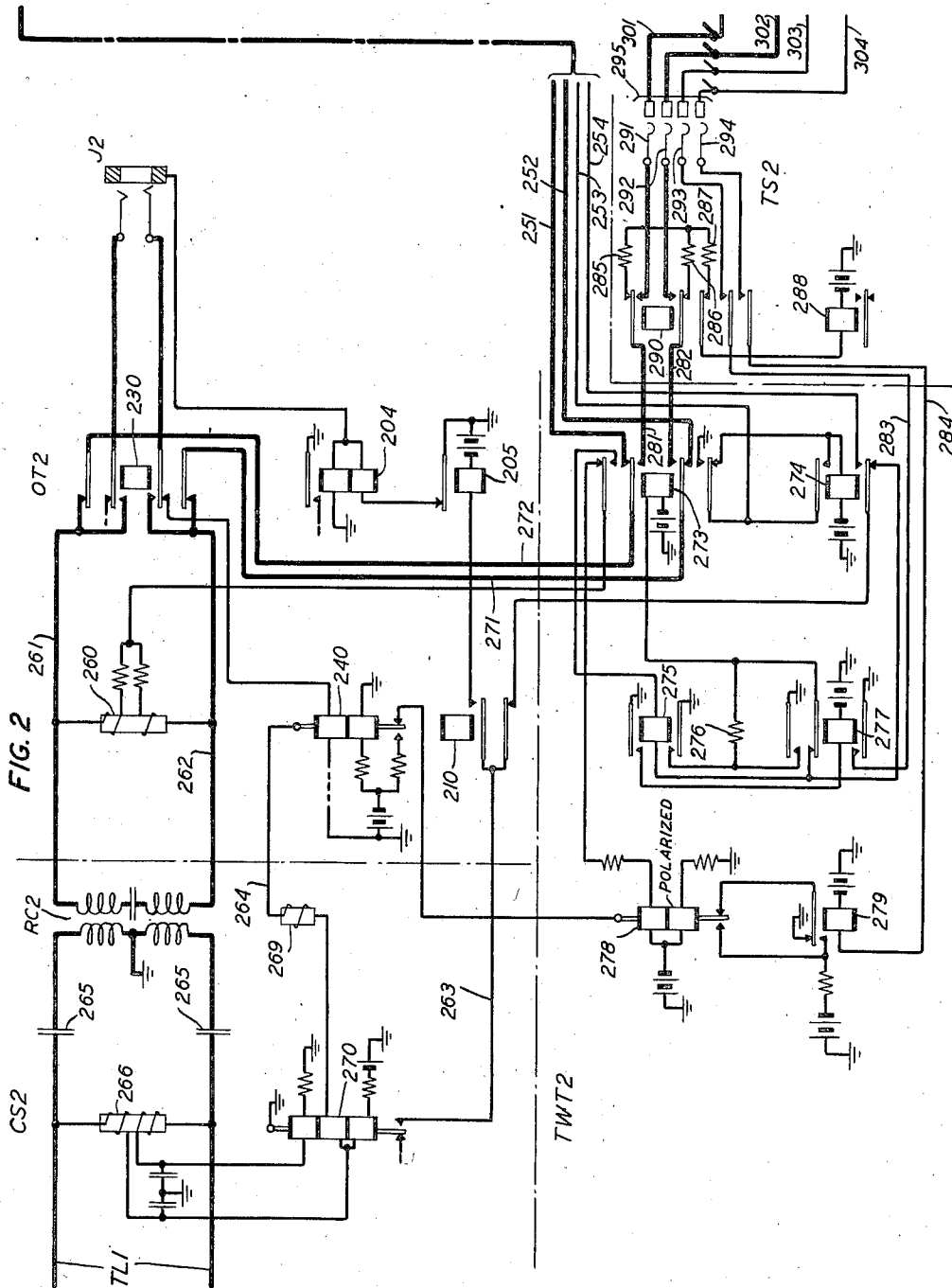
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5 Sheets-Sheet 2



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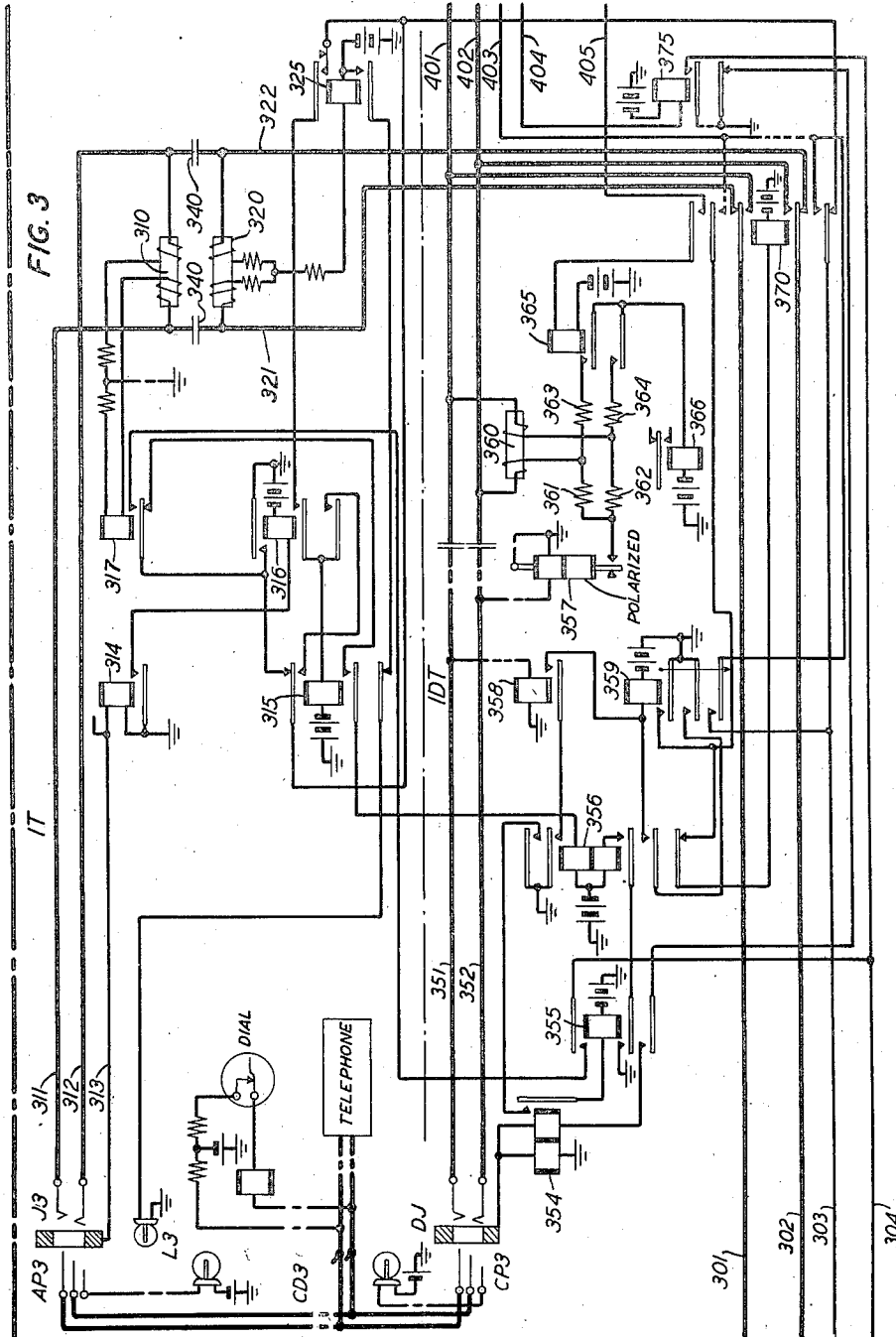
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5 Sheets-Sheet 3



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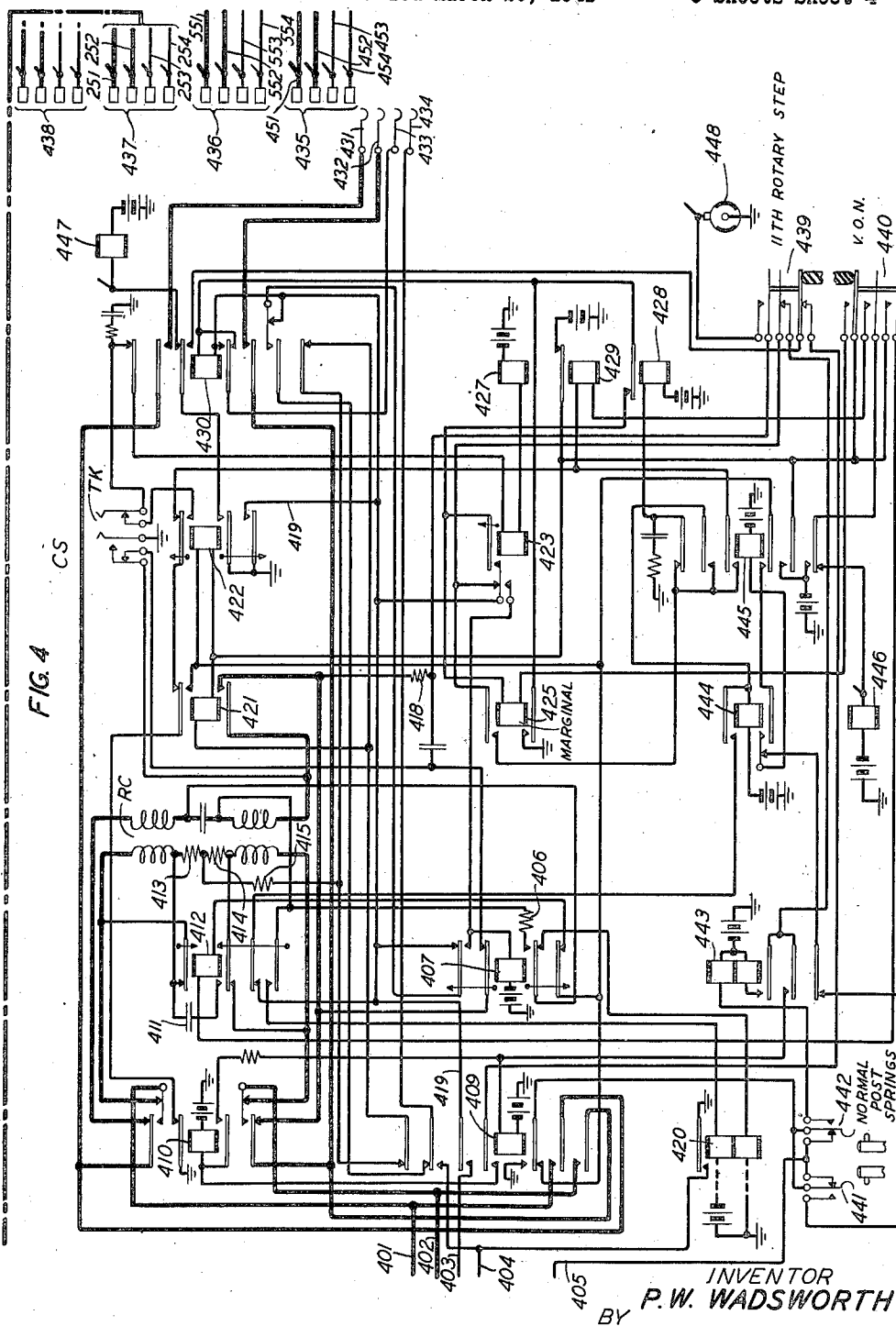
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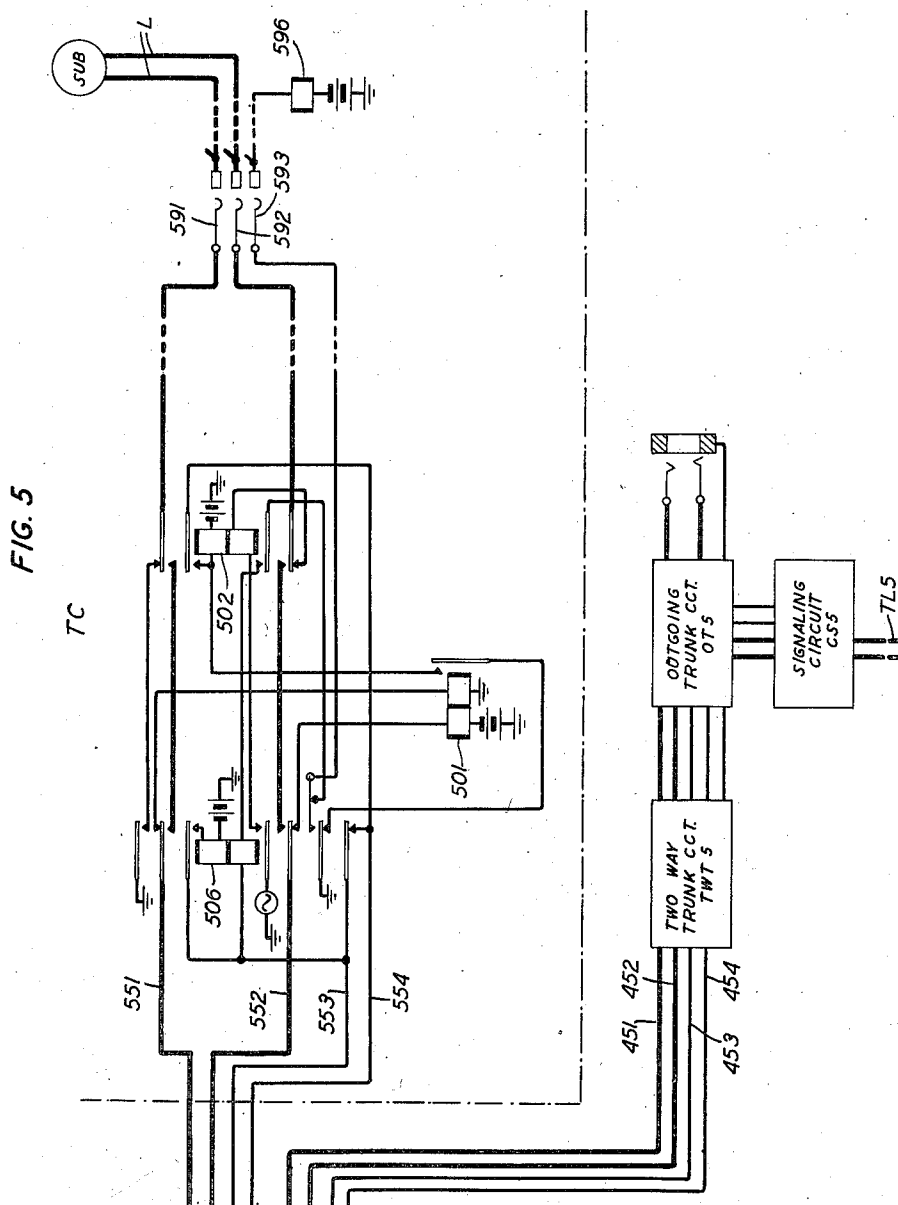
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2,360,291

TELEPHONE SYSTEM

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Application March 20, 1941, Serial No. 384,238

6 Claims. (Cl. 179-27)

This invention relates to telephone systems and particularly to systems in which dial impulse controlled switches are provided for completing connections between calling and called lines.

Objects of the invention are the provision of more efficient automatic switching equipment for establishing telephone connections between calling and called lines and an increase in the utility and efficiency of selectors in toll telephone systems.

According to this invention a selector in a toll office having access to trunks to local dial offices and to trunks to other toll offices is arranged to absorb a first train of directive impulses if the train consists of a certain number of impulses, to receive impulses in a simplex circuit and repeat the impulses in a loop circuit upon selection of a trunk to a local dial office, to function as a toll transmission selector with a repeating coil in the talking connection upon selection of a trunk to a local dial office, and to connect the incoming conductors directly to the conductors of the selected trunk upon selection of an intertoll trunk or an intertoll selector.

According to a feature of the invention a combined intertoll and toll transmission selector is provided with two sets of independently actuated normal post springs, the actuation of one set alone being effective to release the brushes to absorb the first digit, the actuation of the other set alone being effective to cut out the repeating coil which is provided for use upon selection of a trunk to a local dial office, and the actuation of both sets of springs together being effective to indicate, to a preceding trunk circuit, selection of a group of intertoll trunks arranged for through supervision.

A clear and complete understanding of the invention will be facilitated by considering a system in which the invention is embodied, one such system being represented schematically in the drawings which form a part of this specification. The invention is not limited in its application to the particular system shown in the drawings but is generally applicable to toll and intertoll telephone systems.

Referring to the drawings:

Fig. 1 shows, in a first toll office, an operator's cord CD1, telephone and dial, a jack-ended outgoing trunk circuit OT1, and a signaling circuit CS1 associated with a toll line TL1;

Fig. 2 shows, in a second toll office, a signaling circuit CS2, an outgoing trunk circuit OT2, a two-way trunk circuit TWT2 and a toll selector TS2, all associated with the toll line TL1;

Fig. 3 shows, in the second toll office, an operator's cord CD3, telephone and dial, a jack-ended incoming trunk circuit IT, and an associated intermediate dialing trunk circuit IDT connected to terminals in the bank of toll selector TS2 of Fig. 2;

Fig. 4 shows a combined intertoll and toll transmission selector circuit CS associated with the intermediate dialing trunk circuit shown in Fig. 3;

Fig. 5 shows a toll connector TC and a subscriber's line L in a local dial office; and shows a two-way trunk circuit TWT5, outgoing trunk circuit OT5 and signaling circuit CS5 associated with an intertoll trunk TL5; and

Fig. 6 shows the relative position in which Figs. 1 to 5 are to be placed to form an operative arrangement.

Reference may be had to the patent to R. E. King et al. 2,209,777, granted July 30, 1940, for a detailed disclosure of the cord and operator's position circuits provided in each of the two toll offices for interconnecting calling and called lines and trunks and for controlling the completion of toll calls. The outgoing trunk circuits OT1, OT2 and OT5, signaling circuits CS1, CS2 and CS5, and the intertoll selector TS2, are all similar to corresponding circuits disclosed in the aforementioned King et al. patent. The toll connector circuit TC is similar to the toll connector disclosed in the patent to E. D. Butz No. 2,021,286, granted November 19, 1935. Although not shown in the drawings, one or more intermediate selectors may be required for selecting a desired group of toll connectors.

The combined intertoll and toll transmission selector circuit CS comprises a repeating coil RC, a line relay 421, a release relay 422, a relay 410 for switching the repeating coil RC, a vertical stepping magnet 427, a rotary stepping magnet 428, a release magnet 429, a set of brushes 431, 432, 433 and 434, eleventh rotary step springs 439, vertical off-normal springs 440, two sets of normal post springs 441 and 442, a test key TK, and various control relays. The normal post springs 441 are adjusted to be operated only when the brushes are on the tenth level and on any of levels 2 to 9, inclusive, corresponding to digits which are to be absorbed. The normal post springs 442 are adjusted to be operated only when the brushes are on levels 1 and 10. The terminals of the first and tenth levels are connected to intertoll trunks, these levels being represented by terminals 435 and 438, respectively. The terminals 436 represent a level in which the termi-

nals are connected to trunks to a local dial office, neither of the sets of normal post springs being actuated on such a level if selected in response to a first train of impulses; and only springs 441 are actuated if this level is selected in response to a second digit after absorbing a like first digit. If the first level is selected, normal post springs 442 are actuated to switch the repeating coil RC out of the talking connection. With either but not both of springs 441 and 442 actuated ground is connected to conductor 405 to effect the connection of a supervisory relay in the associated intermediate dialing trunk circuit for response to rering and disconnect signals from the calling operator. Upon selection of the tenth level, the actuation of both sets of normal post springs disconnects ground potential from conductor 405 so that no supervisory signals will be given to the intermediate dialing operator, supervisory signals from the calling operator being transmitted through the intermediate dialing trunk circuit and through the selector CS to the selected intertoll trunk.

Further explanation will be facilitated by describing in detail the circuit operations involved on calls originating in the first toll office and routed through the selector circuit CS. Assume first that the plug CP1 of the cord CD1 is inserted in jack J1 of the outgoing trunk circuit OT1 thereby closing a circuit for operating relay 104. Relay 104 effects the operation of relay 110 as described in the aforementioned King et al. patent and closes a circuit for operatively energizing the upper winding of signaling relay 140. The operation of relay 140 connects signaling battery through conductor 164, retard coil 169, middle winding of composite signaling relay 170, upper winding of retard coil 166, upper conductor of toll line TL1, upper winding of retard coil 266 of signaling circuit CS2 in the second toll office, to the windings of composite signaling relay 270. Relay 270 operates, closing a circuit through conductor 263, back contact of relay 210 of outgoing trunk circuit OT2, back contact of relay 274 of two-way trunk circuit TWT2, back contact of relay 277, and the winding of relay 273. Relay 273 operates, connecting ground to conductor 253 to guard the toll line TL1 from seizure in the second toll office. Relay 273 closes a circuit, for operating relay 275, from ground through the front contact of signaling relay 270, conductor 263, back contact of relay 210, back contact of relay 274, winding of relay 275, a front contact of relay 273, thence in simplex through both windings of retard coil 260, back contacts of relay 230, conductors 271 and 272, inner front contacts of relay 273, conductors 281 and 282, back contacts of relay 290, resistors 285, 286 and 287, and through the winding of relay 288 to battery. The line relay 288 of toll selector TS2 is thereby operated in series with relay 275 of the two-way trunk circuit TWT2. Relay 275 closes a circuit through resistor 276 for holding relay 273 and closes a circuit for operating the slow-to-release relay 277. Relay 277 also closes a holding circuit for relay 273 and connects ground potential to conductor 283 to hold the selector TS2 and any succeeding switches or trunks through which a connection may be established. When the calling operator operates the dialing key (not shown) the upper winding of relay 140 is controlled by the impulse contacts of the dial. Each release and reoperation of relay 140, in response to the dialing of the first digit of the called number, opens and closes the circuit through conductor 164 caus-

ing a corresponding release and reoperation of relay 270 of signaling circuit CS2. Relay 270 repeats these dial impulses to relay 275 of two-way trunk circuit TWT2 and to relay 288 of selector TS2. Each release of relay 275 opens the operating circuit of relay 277; but, since this relay is slow in releasing, it maintains the connection of ground to conductor 283 during the response of relay 275 to dial impulses. The alternate release and reoperation of relay 288 causes the brushes of selector TS2 to be stepped up to the level corresponding to the digit dialed. At the end of the train of impulses the brushes 291, 292, 293 and 294 are advanced step by step in the selected level to hunt for and seize a set of terminals connected to an idle trunk. When an unguarded set of terminals is found, relay 290 is operated to disconnect relay 288 and connect toll line TL1, through brushes 291 and 292 and the engaged terminals to the next line, trunk or selector through which the desired connection is being established. For a detailed description of the operation of selector TS2 reference may be had to the aforementioned patent to King et al.

On the call being described, it is assumed that the level selected by switch TS2 is a level in which the terminals are connected to intermediate dialing trunk circuits associated with combined intertoll and toll transmission selectors. The selected set of terminals is represented in the drawing by terminals 295 which are connected, through conductors 301, 302, 303 and 304, to the intermediate dialing trunk circuit IDT of Fig. 3. Upon seizure of terminals 295, the line relay 325 of the incoming trunk circuit IT is operated, the circuit for operating relay 325 being traced from ground at the front contact of signaling relay 270, through conductor 263, back contacts of relays 210 and 274, winding of relay 275, a front contact of relay 273, thence in simplex through both windings of retard coil 260, conductors 261 and 262, back contacts of relay 230, conductors 271 and 272, front contacts of relay 273, conductors 281 and 282, front contacts of relay 290, brushes 291 and 292, conductors 301 and 302, back contacts of relay 370 of intermediate dialing trunk circuit IDT, conductors 321 and 322, both windings of retard coil 320, and through the winding of relay 325 to battery. Relay 325 closes a circuit for lighting the answering lamp L3 associated with jack J3 of the incoming trunk circuit IT. When the call is answered by the insertion of the plug AP3 of a cord CD3 in jack J3, battery is connected through the sleeve conductors of plug AP3 and jack J3 to conductor 313 to operate relay 314. Relay 314 closes a circuit for operating relay 316. Relay 316 closes a circuit for operating relay 315, this circuit being traced from the winding of relay 315, through front contacts of relays 316 and 325, a back contact of relay 370, conductor 303, brush 293, a front contact of relay 290, and through conductor 283 to ground at the lower front contact of relay 277 of two-way trunk circuit TWT2. Relay 315 locks to conductor 303 under control of relay 316 but independent of relay 325, closes a circuit for operatively energizing the upper winding of relay 356 of intermediate dialing trunk circuit IDT, and extinguishes lamp L3. When the dial key at the calling operator's position is restored to normal, relay 130 of outgoing trunk circuit OT1 is operated and relay 140 is held under control of relay 104 in the manner described in the aforementioned King et al. patent. The talking circuit between the calling operator in the first

toll office and the answering operator in the second toll office includes conductors 101 and 102, front contacts of relay 130, conductors 161 and 162, repeating coil RC1, condensers 165, toll line TL1, condensers 265, repeating coil RC2, conductors 261 and 262, back contacts of relay 230, conductors 271 and 272, front contacts of relay 273, conductors 281 and 282, front contacts of relay 290, brushes 291 and 292, conductors 301 and 302, back contacts of relay 370, conductors 321 and 322, condensers 340, and conductors 311 and 312.

To complete the desired connection the answering operator inserts the calling plug CP3 of cord CD3 in the dial jack DJ of the intermediate dialing trunk circuit IDT, thereby causing the operative energization of the left winding of relay 354. Relay 354 closes a circuit for operating relay 355. Relay 355 closes a circuit through the right, low resistance winding of relay 354 and closes a locking circuit for relay 356. When the answering operator actuates the dial key (not shown), battery is connected through the impulse contacts of the dial, the ring conductor of plug CP3 and conductor 352 to operate relay 357; and battery is connected through the tip conductor of plug CP3 and conductor 351 to operate relay 358. Relay 358 closes a circuit for operating relay 359. Relay 359 locks under the sole control of relay 356. Relay 357 closes a simplex circuit through resistors 361 and 362, both windings of retard coil 360, conductors 401 and 402, back contacts of relay 410, back contacts of relay 412, resistors 413 and 414, thence through resistor 415, back contacts of relays 409 and 430 in parallel, winding of relay 421, to battery at the back contact of release magnet 429. Relay 421 closes a circuit for operating relay 422. Relay 422 connects ground through its inner lower front contact and a back contact of relay 430 to the winding of a common, permanent signal alarm relay 447, which operates to cause a maintenance alarm in usual manner in case no dial impulses are received within a predetermined interval of time.

When the intermediate, answering operator dials the first digit of the called route and subscriber's number, relay 357 is alternately released and reoperated to repeat the dial impulses to relay 421. The release of relay 421, in response to the first dial impulse, closes a circuit from ground at inner upper back contact of relay 410, through the back contact of relay 421, upper front contact of relay 422, right contact of test key TK, back contact of relay 430, winding of relay 423, and through the winding of the vertical stepping magnet 427 to battery. The stepping magnet 427 is thereby operated to step the brushes up to the first level of the terminal bank. Vertical off-normal springs 440 are actuated when the brush shaft moves out of normal position. Relay 423 is operated in series with magnet 427; and, when springs 440 are actuated, a circuit is closed from battery at the back contact of release magnet 429, through the upper contact of springs 440, winding of stepping relay 425, front contact of relay 423, conductor 419, to ground at a front contact of relay 422. Relay 425 locks through the back contact of rotary stepping magnet 428, independent of relay 423. Relay 423 closes a circuit for operating relay 407; and relay 407 locks to conductor 419 under control of relays 430 and 422, independent of relay 423. When relay 421 reoperates at the end of the first dial impulse, magnet 427 releases but relay 423 is slow in releasing and does not release until relay 421 remains operated for a predetermined interval

after the last impulse in the train. Relay 422 is slow in releasing and remains operated during the response of relay 421 to dial impulses. The release and reoperation of relay 421, in response to each succeeding impulse in the train created by the dialing of the first digit by the answering operator, causes a corresponding operation and release of the vertical stepping magnet 427, thereby advancing the brushes to the level corresponding to the digit dialed. When relay 423 releases at the end of the train of impulses, it opens the operating circuit of relay 425 but relay 425 is held operated under control of springs 440 and magnet 428.

Assume now that the first digit dialed by the intermediate operator is one which is to be absorbed, the stepping of the brushes to the corresponding level being effective to actuate normal post springs 441 without actuating springs 442. The actuation of springs 441 closes a circuit for operating relay 445, this circuit including back contacts of relays 444 and 443, the front contact of springs 441, lower back contact of relay 409, front contact of relay 421 and back contact of relay 410. The operation of relay 445 prevents the operation of the rotary stepping magnet 428 when relay 423 releases, and connects battery to the windings of relays 421 and 422, independent of release magnet 429. When relay 423 releases, at the end of the train of impulses, a circuit is closed for operating relay 444; this circuit includes front contacts of relays 445 and 425, the back contact of relay 423, conductor 419, and a front contact of relay 422. Relay 444 locks under control of relays 412 and 422, and closes a locking circuit for relay 445 which is independent of relay 409 and springs 441. The aforementioned release of relay 423 at the end of the first digit, closes a circuit for operating release magnet 429; this circuit is traced from battery through the outer lower front contact of relay 445, middle contact of springs 440, winding of release magnet 429, front contacts of relays 445 and 425, back contact of relay 423, conductor 419, to ground at a front contact of relay 422. The operation of release magnet 429 allows the brush shaft to be restored to normal in usual manner. When the shaft reaches normal position, the return of springs 440 to normal causes the release of magnet 429 and the release of relay 425. When the intermediate operator dials the next digit, the dial impulses are repeated by relay 357 to relay 421. The release and reoperation of relay 421 in response to each impulse of the train causes a corresponding operation and release of the vertical stepping magnet 427 to step the brushes to the desired level. The release of relay 421, in response to the first impulse also causes the release of relay 445. Relay 423 operates in series with magnet 427 and remains operated until all of the impulses in the train have been received. When the shaft moves out of normal position, the actuation of springs 440 closes the circuit for operating relay 425 and relay 425 locks under control of the rotary stepping magnet 428. Relay 444 being locked operated, relay 445 cannot be reoperated even though the level selected is one on which normal post springs 441 are actuated. When relay 423 releases at the end of the second train of impulses, or when relay 423 releases at the end of a first train of impulses and relay 445 is not operated, a circuit is closed for operating the rotary stepping magnet 428 to step the brushes into engagement with the first set of terminals in the se-

lected level. The circuit for operating magnet 428 includes the upper back contact of relay 445, upper front contact of relay 425, back contact of relay 423, conductor 419, and a front contact of relay 422. The operation of magnet 428 causes the release of stepping relay 425; and the release of relay 425 causes the release of magnet 428. The release of magnet 428 closes a testing circuit from battery at the back contact of release magnet 429, through the upper contact of springs 440, winding of relay 425, back contact of magnet 428, inner lower back contact of relay 430, through test brush 433 to the engaged test terminal. If the line, trunk or selector connected to the engaged set of terminals is busy, the test terminal has ground potential connected thereto as a guarding potential, and stepping relay 425 reoperates, closing the circuit for operating rotary stepping magnet 428. Magnet 428 then steps the brushes into engagement with the next set of terminals and causes the release of relay 425; and the release of relay 425 causes the release of magnet 428. Relay 425 and stepping magnet 428 thus cooperate to advance the brushes step by step in the selected level to hunt for an unguarded set of terminals. When the test brush 433 engages a terminal which is not connected to ground, the release of magnet 428 closes a circuit for operating relay 430, from battery at the back contact of release magnet 429, upper contact of springs 440, winding of relay 425, back contact of magnet 428, winding of relay 430, conductor 419, to ground at a front contact of relay 422. Being marginal, relay 425 does not operate in series with relay 430. Relay 430 connects ground at the outer lower front contact of relay 422, through conductor 419, the inner lower front contact of relay 430, brush 433 to the engaged terminal as a busy, guarding potential and opens the circuit for operating alarm relay 447.

Assume now that the level in which trunk hunting occurs is one in which the terminals are connected to trunks leading to a local dial office, such a level being represented by the terminals 436. In such a case, the normal post springs 442 are not actuated, relays 409 and 410 are not operated and the operation of relay 430 is ineffective to disconnect relay 421 from conductors 401 and 402. As shown in the drawings the terminals 436 connect directly to a toll connector TC, but intermediate selectors may be provided if necessary to give access to all subscribers in the local dial office, in which case the terminals 436 would be connected to an intermediate selector. The ground potential connected through brush 433 to conductor 553 is further connected through a back contact of relay 506 of connector TC, conductor 554, brush 434, a back contact of relay 409, outer lower front contact of relay 430, and through the upper front contact of relay 407 to the winding of relay 407 to hold this relay operated under control of relay 505 of the toll connector. Relay 430 disconnects the winding of relay 423 from the back contact of relay 421, and closes a circuit, for operating the line relay 501 of connector TC, from battery through the left winding of relay 501, a back contact of relay 506, conductor 552, brush 432, a front contact of relay 430, a back contact of relay 410, lower front contact of relay 421, lower right winding of repeating coil RC, resistor 406, lower front contact of relay 407, upper right winding of repeating coil RC, a back contact of relay 410, a front contact of relay 430, brush 431, conductor 551, a back contact of relay 506, and

through the right winding of relay 501 to ground. Relay 501 closes a circuit for operating relay 502 and relay 502 locks through its inner upper front contact and a back contact of relay 506, through conductor 553, brush 433, inner lower front contact of relay 430, to ground at a front contact of relay 422. The trains of impulses created by the dialing of the last two digits of the called local subscriber's number are repeated by relay 357 to relay 421; and relay 421 repeats these impulses to relay 501 to effect the selective operation of the toll connector TC to seize the called subscriber's line. For a complete description of the operation of a toll connector reference may be had to the aforementioned patent to E. D. Butz. When the brushes of toll connector TC engage the terminals of the called line and the called line is idle, relay 506 is operated by the energization of its lower winding in series with test brush 593 and the cut-off relay 596 of the called subscriber's line circuit. Relay 506 locks the conductor 553, disconnects relay 501 from conductors 551 and 552, and opens the connection between conductors 553 and 554, thereby causing the release of relays 501, 502, and 407. The release of relay 407 opens the bridge through resistor 406 across brushes 431 and 432, connects the lower winding of relay 420 to brush 431, and closes a circuit for operating relay 412. Relay 412 opens the short circuits across the left windings of repeating coil RC, connects talking condenser 411 between these windings, and connects the upper winding of relay 420 to brush 432. The release of relay 502 closes the ringing circuit for signaling the called station. If and when the call is answered, relay 502 is reoperated and locks through conductor 554, brush 434, a back contact of relay 409, a front contact of relay 430, and a back contact of relay 407, through conductor 419, to ground at a front contact of relay 422. With relays 506 and 502 operated, conductors 551 and 552 are connected through brushes 591 and 592 to the line L, talking battery being supplied through the windings of relay 420. The operation of relay 420 connects ground to conductor 404 operating relay 375. Relay 375 opens the circuit through the low resistance, right winding of relay 354 to extinguish the supervisory lamp associated with plug CP3 of cord CD3 but does not connect ground to conductor 304 until the intermediate operator disconnects cord CD3 from both of jacks J3 and DJ. When plug AP3 is disconnected from jack J3 relays 314, 316 and 315 release in succession. When plug CP3 is disconnected from jack DJ, relays 354, 357 and 358 release. The release of relay 354 causes the release of relays 355 and 356 in succession. The release of relays 356 and 358 causes the release of relay 359. Relay 359 is slow in releasing; and before relay 359 releases, a circuit is closed from ground through the inner lower front contact of relay 359 and lower back contact of relay 356 for operating relay 370. Relay 370 locks to conductor 303, disconnects conductors 301 and 302 from the winding of relay 325, and connects these conductors to and through conductors 401 and 402 to the winding of relay 421. Relay 421 is thereby held operated in series with relay 275 under control of relay 270. Since normal post springs 442 are normal, ground at the inner upper back contact of relay 410 is connected through the upper front contact of relay 421, lower back contact of relay 409, back contact of springs 442, conductor 405, and a front contact of relay 370 to the winding of relay 365 of the intermediate dialing trunk circuit IDT. Relay

365 operates, connecting the winding of supervisory relay 366, through resistors 363 and 364 and both windings of retard coil 360 to conductors 401 and 402, thence through front contacts of relay 370 to conductors 301 and 302 in parallel with relay 421 of selector CS. After relay 356 has released, ground is connected through a front contact of relay 375, conductor 304, brush 294, and a front contact of relay 290, to conductor 284 to operate relay 279 of two-way trunk circuit TWT2. Relay 279 connects signaling battery through its front contact, back contacts of relays 278 and 240, retard coil 269, the middle winding of relay 270 and upper winding of retard coil 266 to the upper conductor of toll line TL1 to cause the operation of composite signaling relay 170. Relay 170 closes a circuit including a front contact of relay 110, for operating relay 105; and relay 105 opens the circuit through the lower, low resistance winding of relay 104 to extinguish the supervisory lamp associated with plug CPI of cord CD1. The aforementioned operation of relay 370 also connects conductor 303 to conductor 403; but this is without effect since relay 409 of selector CS is not operated. Switchhook supervision is repeated by relays 420, 375, 279, 170 and 105 to the calling operator.

When the calling operator disconnects, relays 104, 110, 130 and 140 are released. The release of relay 140 causes the release of relay 270. The release of relay 270 causes the release of relays 275, 366 and 421. The release of relay 421 causes the release of relays 501, 422 and 365. The release of relay 275 causes the release of relay 277. The release of relay 277 disconnects holding ground potential from conductor 283 thereby causing the return of selector TS2 to normal in the manner described in the aforementioned King et al. patent and causing the release of relay 370. The release of relay 422 causes the release of relay 430 and the operation of release magnet 429 in series with the common relay 446 to cause the shaft and brushes of selector CS to be restored to normal. When the shaft reaches normal, springs 440 are restored to normal causing the release of magnet 429. The aforementioned release of relay 422 also disconnects ground from brushes 433 and 434, causing the release of relays 502, 506 and 596.

Assume next that the level in which trunk hunting occurs is the first level, in which level the terminals are connected to intertoll trunks. The terminals 435 representing this level are connected to a two-way trunk circuit TWT5 associated with an intertoll trunk or toll line TL5. The trunk circuit TWT5, and the associated outgoing trunk circuit OT5 and signaling circuit CS5 are all similar to the corresponding circuits associated with toll line TL1. Upon selection of the first level, the normal post springs 441 are not actuated but the normal post springs 442 are actuated, closing a circuit for operatively energizing the upper winding of relay 443. When relay 423 releases, it closes circuits including the middle contact of the eleventh rotary step springs 439 for energizing the lower, locking winding of relay 443 and for operatively energizing the winding of relay 409. Relay 409 connects conductors 401 and 402 to contacts of relay 430, connects conductor 404 to brush 434, and connects ground directly to the middle contacts of springs 441 and 442. Trunk hunting occurs in the manner hereinbefore described, relay 430 being operated when an unguarded set of terminals is found. The operation of relay 75

430 extends the connection from conductors 401 and 402, through front contacts of relays 409 and 430, brushes 431 and 432 and through selected terminals 435, to the line conductors 451 and 452 of the trunk circuit TWT5 connected to the seized terminals. Since relay 409 is operated, the operation of relay 430 causes the release of relays 421 and 422 in succession. Holding ground potential at the front contact of relay 277 of two-way trunk circuit TWT2 is connected through brush 293 of selector TS2, conductor 303, front contact of relay 359, conductor 403, front contact of relay 409, conductor 419 to the winding of relay 430 to hold relay 430 operated and from conductor 419 through the inner lower front contact of relay 430 and brush 433 to conductor 453 to hold the intertoll trunk circuit connected to the seized terminals. The operation of relay 430 also causes the release of relay 407 and closes a circuit from the winding of relay 410, through the inner upper front contact of relay 409, the lower back contact of the eleventh rotary step springs 439 and front contacts of relays 430 and 422, operating relay 410. Relay 410 locks in parallel with relay 409 and the lower winding of relay 443, through the middle contact of springs 439 and back contact of relay 423 to holding ground potential on conductor 419. Relay 410 disconnects ground from the armature of relay 421 to prevent the operation of release magnet 429 when relay 422 releases. Relay 410 also connects conductors 401 and 402 through talking metal contacts to brushes 431 and 432 in parallel with front contacts of relay 409. When the intermediate dialing operator dials the succeeding digits of the called route and subscriber's number, relay 357 repeats these impulses in the simplex circuit through resistors 361 and 362, windings of retard coil 360, conductors 401 and 402, front contacts of relays 410 and 430, through brushes 431 and 432, to the trunk circuit TWT5 to effect the transmission of corresponding signals over the toll line TL5. When the intermediate dialing operator has completed dialing and disconnects cord CD3 from jacks J3 and DJ, relays 314, 315, 316, 354, 355, 356, 357, 358 and 359 are released and relay 370 is operated in the manner hereinbefore described. The operation of relay 370 releases relay 325, and completes the talking connection between toll lines TL1 and TL5 by connecting conductors 301 and 302 to conductors 401 and 402. The repeating coil RC is not included in this connection and relay 420 is not used. Normal post springs 441 being normal, relay 365 of trunk circuit IDT is operated as hereinbefore described to connect relay 366 to conductors 401 and 402, thence through front contacts of relay 370 to conductors 301 and 302, so that relay 366 is controlled by signaling relay 270. When the calling operator releases the connection, all of the circuits are restored to normal as hereinbefore described.

Assume now that the selector CS selects the tenth level in which the terminals are connected to intertoll trunks which are similar to the intertoll trunks in level 1 except that no supervision is to be given by the intermediate operator. Upon selection of the tenth level both of the sets of normal post springs 441 and 442 are actuated to disconnect ground from conductor 405 and thereby prevent the operation of relay 365 of the intermediate dialing trunk circuit IDT; and since relay 365 is not operated, relay 366 is not connected to conductors 301 and 302. Answer-

ing supervisory signals are transmitted from the seized intertoll trunk, through brush 434 and a front contact of relay 405 to relay 375 of the intermediate dialing trunk circuit IDT. Relay 375 repeats the answering supervisory signals through conductor 304, brush 294 and conductor 284 to relay 279 of two-way trunk circuit TWT2; and relay 279 repeats these signals over toll line TL1 to control the supervisory lamp of the calling operator's cord CD1 in the manner hereinbefore described. When the calling operator disconnects, the outgoing trunk circuit is restored to normal, signaling relay 270 releases, two-way trunk circuit TWT2 is restored to normal, and a disconnect signal is transmitted over the intertoll dialing trunk. The release of relay 277 of two-way trunk circuit TWT2 causes the release of relay 290 to restore selector TS2 to normal, the release of relay 370 to restore the intermediate dialing trunk IDT to normal, and the release of relays 409, 410, 430 and 443 to restore selector CS to normal.

If, when the brushes of selector CS are being advanced in a selected level to hunt for an unguarded set of terminals, all trunks connected to this level are busy, the brushes are advanced to the eleventh rotary position, actuating springs 439 to cause the release of relays 409, 410 and 443 if operated. Relay 430 is operated and relay 425 remains normal. The operation of relay 430 causes the release of relay 407. With relays 407 and 410 normal, relay 412 is operated. The operation of relay 412, with springs 439 actuated, connects interrupter 448 through resistor 418, front contact of relay 421, lower right winding of repeating coil RC, and through the lowermost front contact of relay 412 to the upper winding of relay 420 causing the alternate operation and release of relay 420. The alternate operation and release of relay 420 causes like operations of relays 375, 279, 170 and 105 in succession to flash the supervisory lamp of the calling operator's cord. When the calling operator disconnects cord CD1 from jack J1, the various circuit units are restored to normal as hereinbefore described.

The test key TK enables the testing of relay 421 to insure satisfactory impulse repeating.

Various modifications of each of the circuit units and of the trunking, switching and signaling arrangements may be made. The aforementioned King et al. patent is illustrative of a somewhat larger system to which this invention is applicable.

What is claimed is:

1. In a telephone system, a selector comprising incoming, talking and supervisory conductors, a bank of terminals divided into groups, brushes for connecting with any set of terminals, means for advancing the brushes to select any desired group, and means for advancing the brushes to select an unguarded set of terminals in a selected group, a group of intertoll trunks connected to one of said groups of terminals, a group of trunks to a local dial office connected to another of said groups of terminals, means including a repeating coil for completing a talking connection between said incoming conductors and the brushes of the selector on calls to a local dial office, and means comprising contact springs actuated responsive to selection of a group of intertoll trunks for effecting the direct connection of said incoming conductors to said brushes, said direct connection excluding said repeating coil.

2. In a telephone system, a selector comprising

incoming conductors through which said selector is seized, a set of brushes, a bank of terminals divided into levels, means controlled by digit impulses for selecting any desired one of said levels, means for advancing the brushes into engagement with an unguarded set of terminals in any selected level, and two sets of independently actuated normal post springs, a group of intertoll trunks connected to the terminals in one of said levels, a group of trunks to a local dial office connected to the terminals in another of said levels, one of said sets of normal post springs adapted to be actuated upon selection of a level giving access to said intertoll trunks, the other set of normal post springs adapted to be actuated upon selection of a particular level, a repeating coil normally connected between said incoming conductors and the brushes of said selector upon selection of a set of terminals in a selected level, means rendered effective upon selection of a set of terminals in a level on which said one set of normal post springs are actuated for switching said repeating coil out of the connection between said incoming conductors and said brushes, and means comprising said other set of normal post springs for effecting the release of the brushes upon selection of said particular level to absorb the train of directive impulses effecting seizure of said particular level.

3. In a telephone system, a trunk circuit, a selector individual to said trunk circuit, said selector comprising a terminal bank divided into levels, brushes for connecting with any set of terminals in said bank, means comprising an impulse relay in said trunk circuit for receiving trains of directive impulses, means controlled by said impulse relay in a simplex circuit over the talking conductors between said trunk circuit and said selector for advancing the brushes to select any desired level, means for automatically advancing the brushes in a selected level to hunt for and seize an unguarded set of terminals, two independently actuated sets of normal post springs for said selector, one of said sets of springs actuated upon selection of a particular level, means controlled by said one set of springs for effecting the return of the brushes to normal, a repeating coil normally included in the connection between said trunk circuit and the brushes of said selector upon selection of a set of terminals in a selected level, the other of said sets of normal post springs actuated upon selection of a certain level, and means controlled by said other set of springs for switching said repeating coil out of the talking connection between said trunk circuit and said brushes.

4. In a telephone system, an operator's position including means for answering calls and an impulse sender for controlling selector switches, an intermediate dialing trunk circuit comprising incoming conductors through which said trunk circuit may be seized and conductors terminating at said operator's position for answering a call upon seizure of said trunk circuit, a selector individual to said trunk circuit, said selector comprising a terminal bank divided into levels, brushes for connecting with any set of terminals in said bank, means controlled by directive impulses for selecting any level, and means for automatically selecting an unguarded set of terminals in any selected level, means in said intermediate dialing trunk circuit including conductors terminating at said position responsive to the operation of said impulse sender for controlling the selective operation of said selector,

said selector further comprising two independently actuated sets of normal post springs, one of said sets of springs adapted to be actuated upon selection of a particular level, means effective in response to the actuation of said one set of normal post springs to return the brushes to normal to absorb the impulses effecting seizure of said particular level, a repeating coil normally included in the talking connection between said trunk circuit and said brushes upon selection of a set of terminals in a selected level, the other of said sets of springs adapted to be actuated upon selection of another particular level, and means effective in response to the actuation of said other set of normal post springs for switching said repeating coil out of the talking connection between said trunk circuit and said brushes.

5. In a telephone system, an operator's position including means for answering calls and an impulse sender for controlling selector switches, an intermediate dialing trunk circuit comprising incoming conductors through which said trunk circuit may be seized and conductors terminating at said operator's position for answering a call upon seizure of said trunk circuit, a selector individual to said trunk circuit, said selector comprising a terminal bank divided into levels, brushes for connecting with any set of terminals in said bank, means controlled by directive impulses for selecting any level, and means for automatically selecting an unguarded set of terminals in any selected level, means in said intermediate dialing trunk circuit including conductors terminating at said position responsive to the operation of said impulse sender for controlling the selective operation of said selector, said selector further comprising two independently actuated sets of normal post springs, one of said sets of springs adapted to be actuated upon selection of certain levels including a particular level, means effective in response to the actuation of said one set of normal post springs upon selection of said particular level to return said brushes to normal to absorb the train of impulses effecting seizure of said particular level, a repeating coil normally included in the talking connection between said trunk circuit and said brushes upon selection of a set of terminals in a selected level, the other of said sets of normal post springs adapted to be actuated upon selection of certain levels including a level on which said one set of springs are not actuated, means effective in response to the actuation of said other set of springs for switching said repeating coil out of the connection between said trunk circuit and said brushes, means in said trunk circuit for connecting said incoming conductors to said selector, supervisory means in said trunk circuit, and means effective upon connection of said incoming conductors to said selector to connect said supervisory means to said incoming conductors, said last-mentioned means being rendered inoperative by said normal post springs

upon selection of a level on which both of said sets of springs are actuated.

6. In a toll office of a telephone system, a selector for use in completing desired telephone connections, talking conductors, a holding conductor, and two supervisory conductors leading to said selector, said selector comprising a bank of terminals divided into levels, a set of brushes for connecting with any set of terminals in said bank, means comprising an impulse relay connected to both of said incoming talking conductors in parallel for controlling the movement of said brushes to select any desired level, and means for advancing the brushes to select an unguarded set of terminals in any selected level, a first group of intertoll trunks connected to a first level of said bank, a group of trunks leading to a local dial office connected to a second level of said bank, a second group of intertoll trunks connected to a third level of said bank, two independently actuated sets of normal post springs for said selector, a first one of said sets of springs actuated upon selection of a particular level, means rendered effective by the actuation of said first set of springs upon selection of said particular level in response to a first train of impulses incoming to said impulse relay to return the brushes to normal to absorb the first train of impulses, means including a repeating coil for completing a talking connection between said talking conductors and said brushes upon selection of a set of terminals in the level connected to trunks to a local dial office, the second one of said sets of springs actuated upon selection of the level to which said first group of intertoll trunks are connected, means controlled by said second set of springs for connecting said incoming talking conductors directly to said brushes upon selection of a set of terminals in either of the levels connected to intertoll trunks, means including said holding conductor for maintaining the connection with a selected set of terminals in any level, a supervisory relay in said selector effective on a call to the local dial office for transmitting supervisory signals over one of said two supervisory conductors, means including a brush of said selector for transmitting signals from a selected intertoll trunk over said one of the two supervisory conductors, means including a normally closed contact of said first set of normal post springs for connecting ground potential to the other of said two supervisory conductors on a call to a trunk to a local dial office, and means including a normally closed contact of said second set of normal post springs for connecting ground potential to said other of the two supervisory conductors on a call to a trunk in said first group of intertoll trunks, both of said sets of normal post springs being actuated to prevent the connection of ground potential to said other of the two supervisory conductors on a call to a trunk in said second group of intertoll trunks.

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