

March 16, 1937.

J. E. NORTON

2,073,752

TELEPHONE SYSTEM

Filed March 25, 1936

4 Sheets-Sheet 1

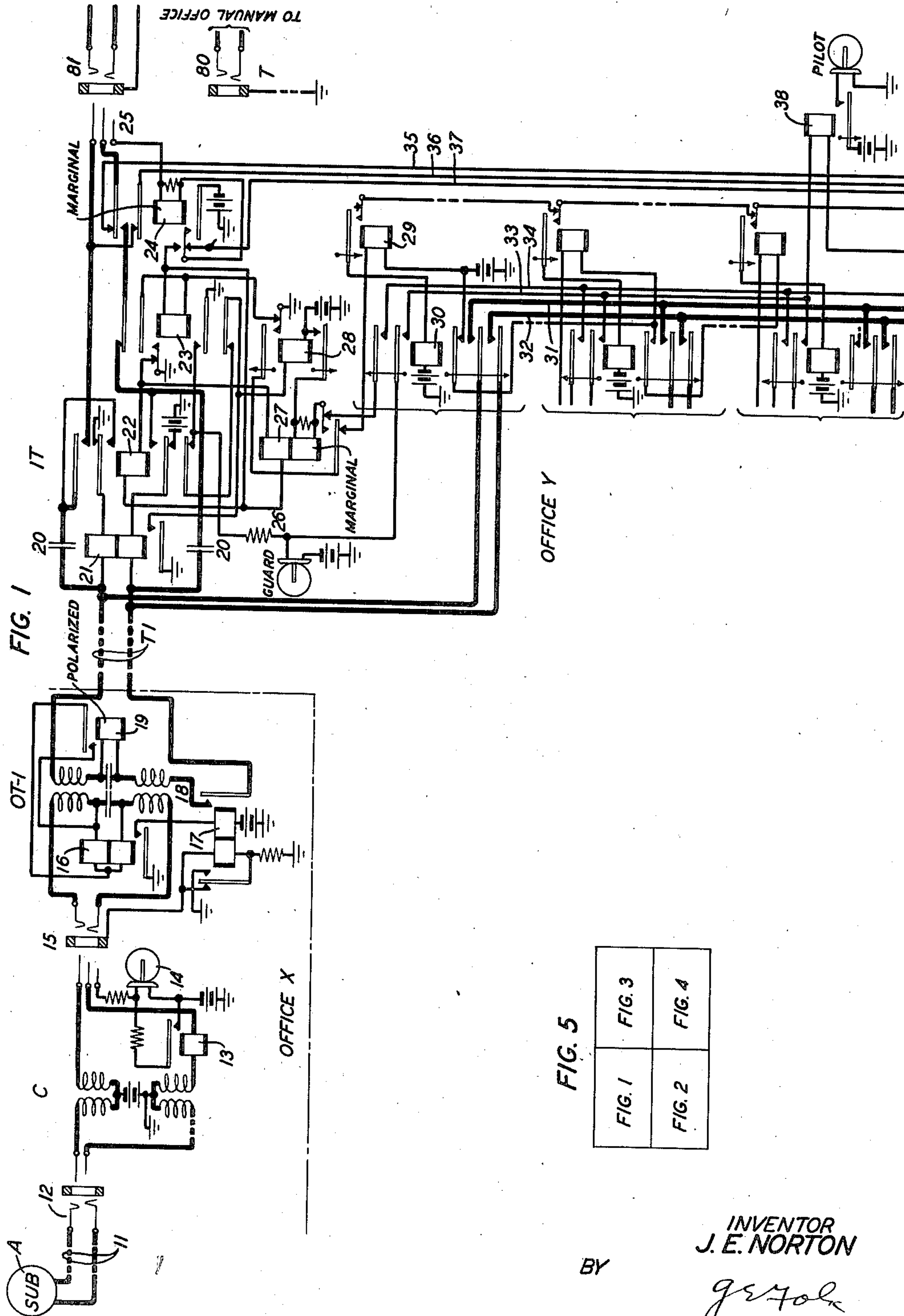


FIG. 5

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

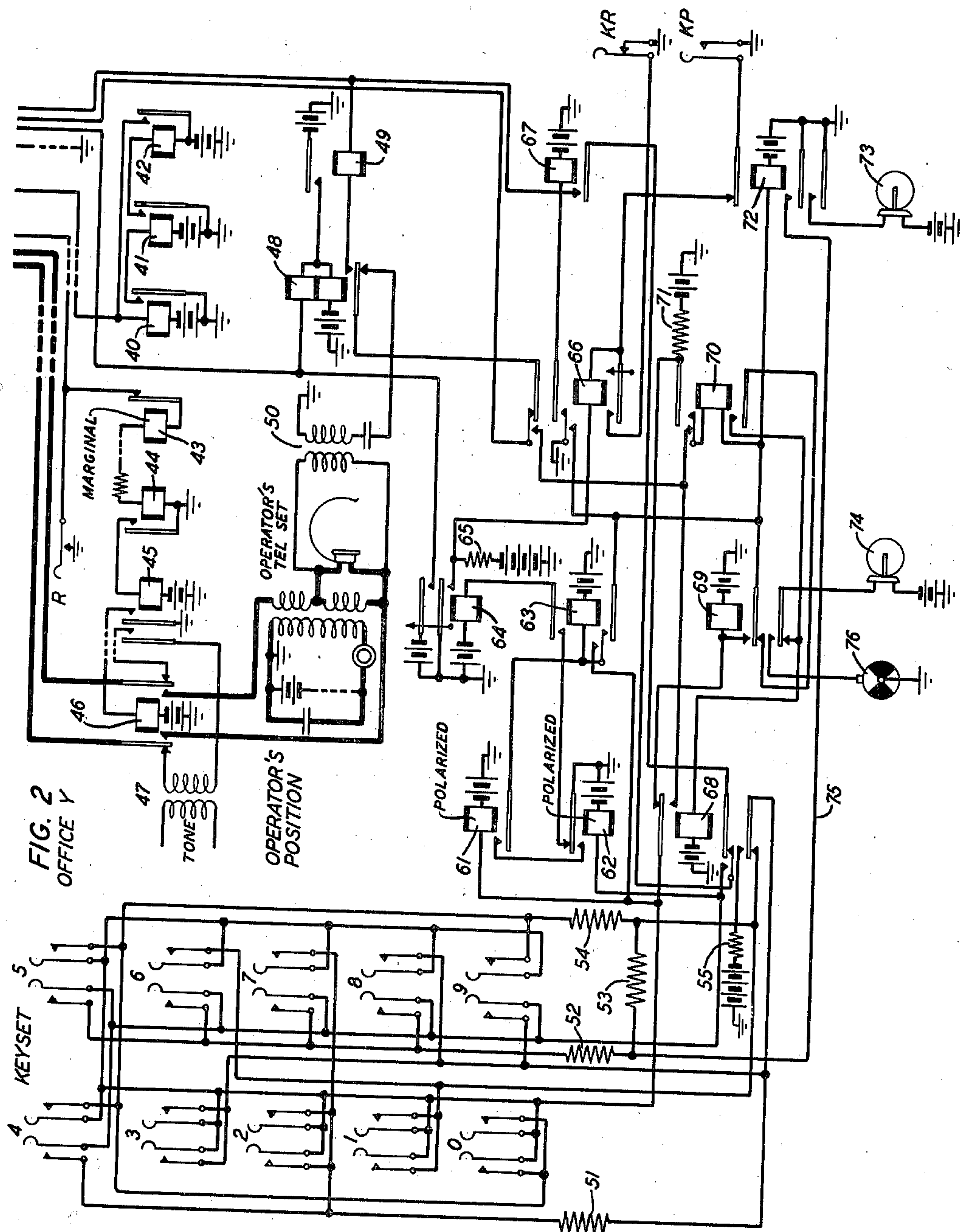


FIG. 2
OFFICE Y

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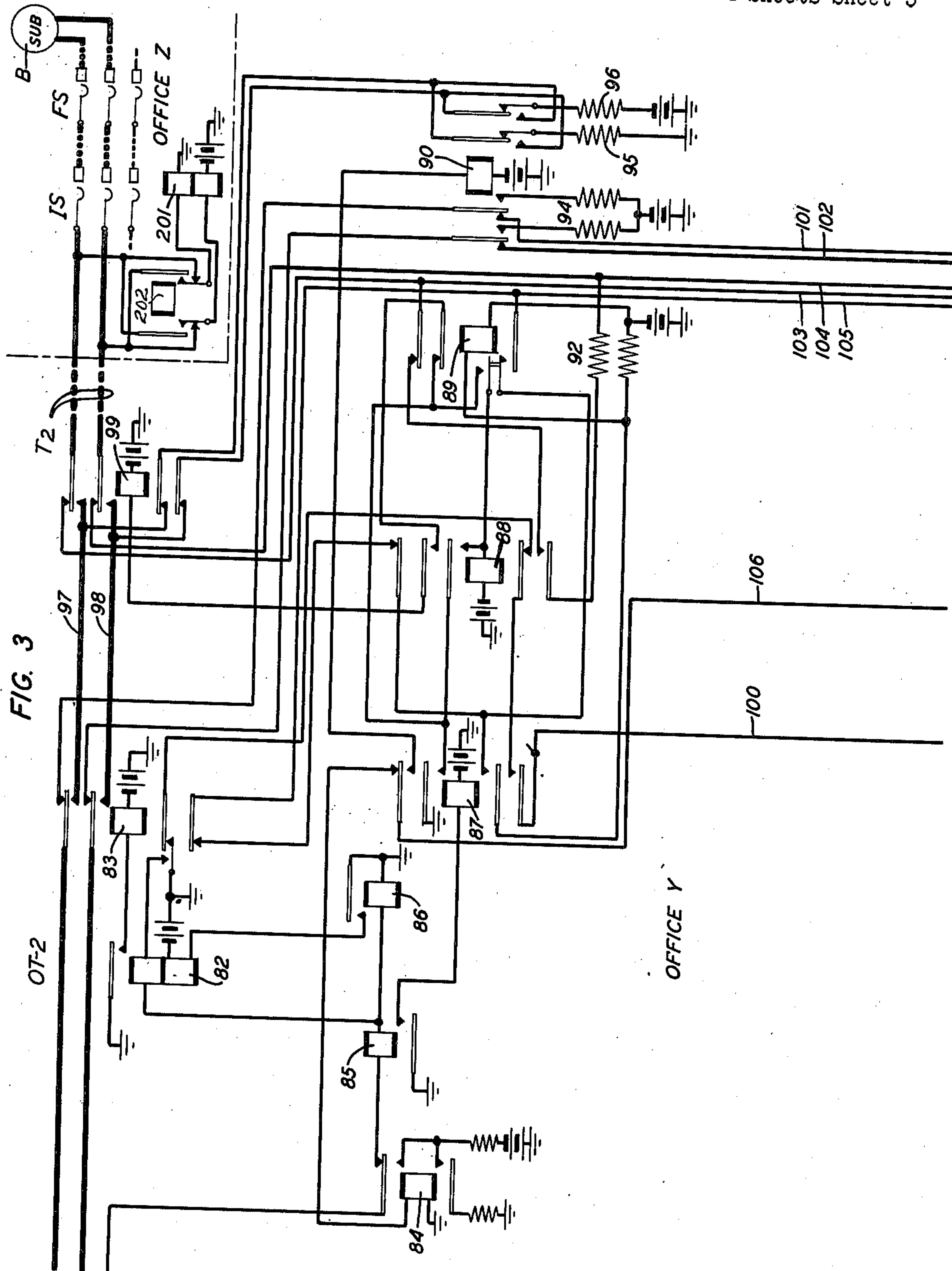
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4 Sheets-Sheet 3



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4 Sheets-Sheet 4

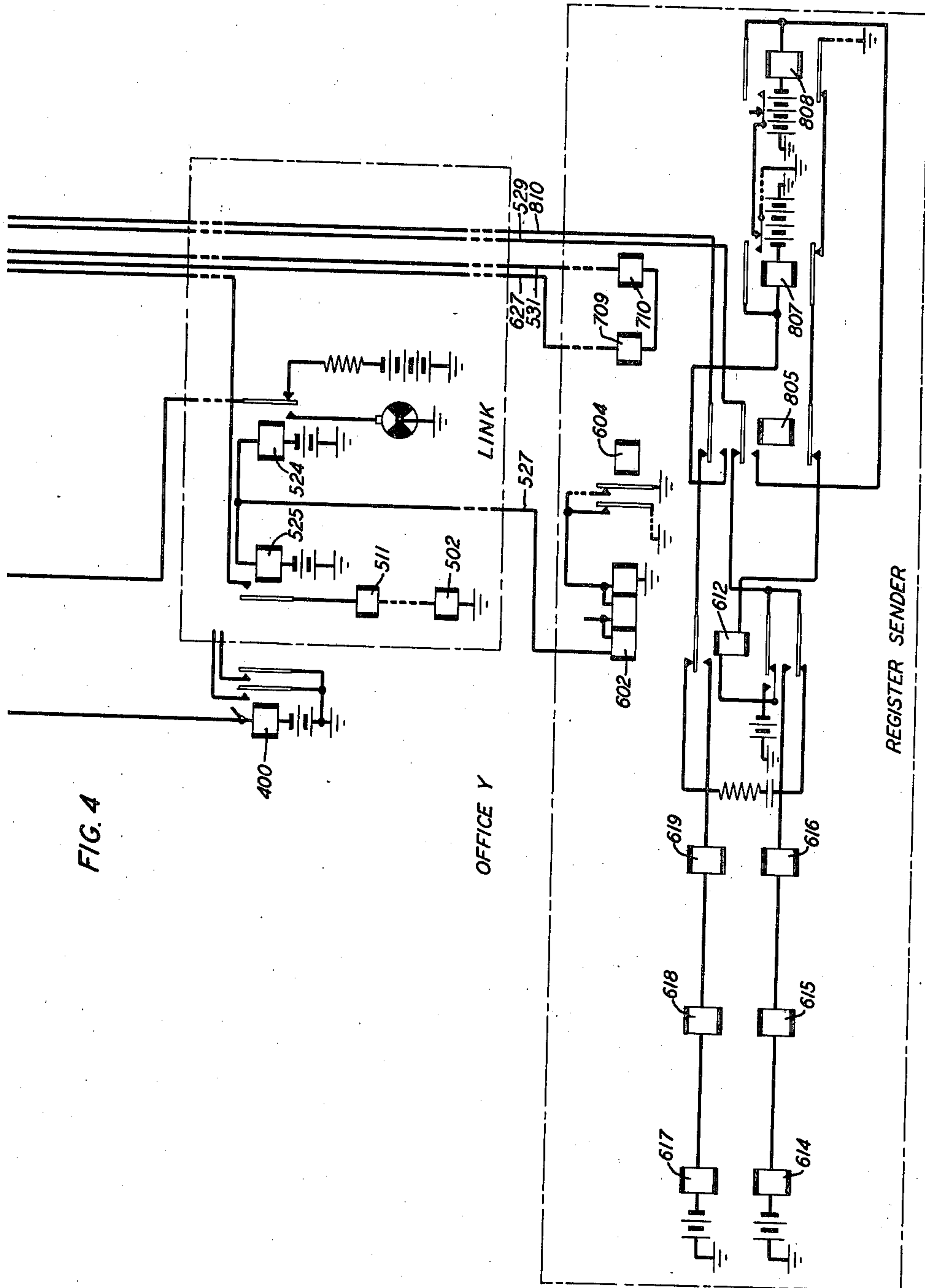


FIG. 4

OFFICE Y

REGISTER SENDER

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2,073,752

TELEPHONE SYSTEM

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Application March 25, 1936, Serial No. 70,865

6 Claims. (Cl. 179—27)

This invention relates to telephone systems and particularly to semi-automatic telephone systems.

It is the object of the invention to facilitate the completion of calls through a manual tandem switchboard to subscribers' lines in an automatic office.

In multi-office telephone systems it may be too expensive to provide direct trunks between each office and all of the other offices, in which case a tandem office is provided to concentrate the interoffice traffic. In systems which include a manual tandem office and an automatic local office, it is usual to provide a cordless "B" board in the automatic office for completing calls incoming from the tandem or other manual offices. According to this invention, operators' keyset and control apparatus and one or more register senders are provided in the tandem office in place of providing a cordless "B" board in the automatic office. Upon answer of an incoming call by the tandem operator an extension of the incoming trunk to an idle trunk outgoing to the automatic office, an idle register sender is automatically connected to the seized outgoing trunk and by operation of the numerical keys at the operator's position, the called number is registered and the register sender is thereupon effective to control an incoming selector and a final selector in the automatic office to complete connection with the called subscriber's line. A feature of the invention is the provision of relay means for holding the line relay of the incoming trunk after the keying of the called number is completed until the sender is dismissed.

The invention will be more readily understood by considering a telephone system in which the invention is embodied. One such system is illustrated schematically in the drawings which form a part of this specification. The invention is, of course, not limited in its application to the particular system shown in the drawings but may be applied to any system in which an intermediate manual operator is provided with key-set equipment for use in completing calls to automatic offices.

Referring to the drawings,

Figure 1 represents a subscriber's station A, a cord C, and an outgoing trunk circuit OT—1 all of which are in a manual office X; Fig. 1 also shows an incoming trunk circuit IT in a manual tandem office Y;

Fig. 2 represents an operator's position comprising telephone, key-set, and associated control equipment in the tandem office Y;

Fig. 3 represents an outgoing trunk circuit OT—2 in the tandem office Y and also an incoming selector IS, final selector FS, and called subscriber's station B in an automatic office Z;

Fig. 4 represents a portion of a register sender in the tandem office Y which sender is operatively connected by a link with the trunk circuit OT—2 of Fig. 3; and

Fig. 5 shows the position in which Figs. 1 to 4, inclusive, should be placed to form an operative system.

The office X is a manual common battery office, the cord C being one of the cords at an "A" operator's position for use in answering calls and extending calling lines to idle outgoing trunks. The outgoing trunk equipment OT—1 associated with trunk T1 extending to the tandem office Y provides for repeating coil transmission of voice currents and polarized supervisory signaling over trunk T1 the usual high-low supervisory relay being bridged across the tip and ring conductors of the cord.

The incoming trunk equipment IT in tandem office Y is a modification of the incoming trunk disclosed in Fig. 1 of Patent 1,629,099, granted to C. B. Fowler May 17, 1927; the modification enables the use of key-set pulsing equipment in extending calls to automatic offices. The relays 29 and 30 of trunk equipment IT and the corresponding relays for other incoming trunks constitute a sequence control whereby the tandem operator's position and telephone equipment is connected to the incoming trunks in succession in the manner disclosed in the aforementioned Fowler patent. The key-set and associated control apparatus provided at the tandem operator's position is substantially the same as that disclosed and described in Patent 1,780,906, issued to Carpenter et al. November 11, 1930. The link and register sender equipments in the tandem office are similar to those disclosed in Figs. 4, 5, 6 and 7 of the aforementioned Carpenter et al. patent and reference thereto may be had for a detailed description of the operation of these equipments. Only so much of a link and a register sender are shown in the drawings as is required for a clear and complete description of the present invention; the reference characters applied to the various elements shown are the same as the reference characters applied to these elements in the aforementioned Carpenter et al. patent. The switches IS and FS in office Z are of the panel type adapted for revertive control by a register sender; reference may be had to Patent No. 1,658,829, issued to C. H. Berry, Feb-

ruary 14, 1928 for a description of the operation of the incoming and final selector switches.

Upon origination of a call at a station A and answer of the call by an operator in office X in well-known manner, the line 11 is extended through jack 12, cord C, and jack 15 to the outgoing trunk circuit OT—1 and thence over the interoffice trunk T1 to the incoming trunk circuit IT in the tandem office Y. Operation of the line relay 21 of equipment IT effects the automatic extension of the call to the tandem operator's telephone set; and, upon the called office name and line number being received from the "A" operator in office X, the tandem operator inserts the plug 25 of equipment IT in a jack connected to an idle trunk leading to the called office. If the called line is in an automatic office, an idle register sender is thereupon automatically associated with the outgoing trunk equipment OT—2. The operator also depresses the position key KP to operatively associate the position key-set and associated control apparatus with the trunk equipment IT and operates the non-locking numerical keys corresponding to the digits of the called subscriber's number. The number of the called station is thus registered in the associated register sender. Upon completion of keying, the key-set and key control apparatus are disconnected from the trunk equipment IT and the conductors of the incoming trunk IT are cut through to the outgoing trunk equipment OT, so that the line relay 21 of equipment IT will be held operated until the register sender is dismissed. Upon registration of the keyed number, the register sender proceeds to control, over the trunk T2, the setting of the incoming selector IS and final selector FS in the called office. Upon completion of the setting of these switches, the register sender is disconnected from the outgoing trunk equipment OT—2 and the connection is cut through to the conductors of trunk T2 so that the line relay 21 of equipment IT is held operated over trunk T2 in series with the calling supervisory relay 201 of the incoming selector IS. Upon answer of the called subscriber the current over trunks T2 and T1 is reversed to cause the operation of the polarized supervisory relay 19 in the outgoing trunk equipment OT—1 in office X and operation of the supervisory relay 13 in cord C. When the cord C is disconnected from trunk equipment OT—1, relay 21 of trunk equipment IT and the supervisory relay of the incoming selector IS release; the tandem operator receives a disconnect signal and the switches IS and FS are returned to normal in usual manner. When the tandem operator disconnects trunk equipment IT from the trunk equipment OT—2, these equipments are completely restored to normal.

A detailed description of the portion of the system directly relating to the application of this invention follows:

When the operator in office X inserts the plug of a cord C in jack 15, relay 16 operates in an obvious circuit, and supervisory lamp 14 is lighted. Relay 16 causes the operation of relay 17 and relay 17 closes a circuit for operating relay 21 in trunk equipment IT of tandem office Y. This circuit is traced from battery at the inner lower back contact of relay 22, through the lower winding of relay 21, lower conductor of trunk T1, front contact of relay 17, lower right winding of repeating coil 18, winding of polarized relay 19, upper right winding of repeating coil 18, upper conductor of trunk T1, upper winding of relay 21,

to ground at the upper back contact of relay 22. The current in this circuit is ineffective to operate polarized relay 19. Relay 21 closes an obvious circuit for operating relay 28 and a circuit, for lighting the trunk guard lamp, from battery through the lamp, resistor 26, lowermost back contact of relay 22, lower back contact of relay 23, to ground at the front contact of relay 21. Relay 28 closes at its upper front contact a circuit for operating the start relay 29. Relays 29 and 30 of trunk equipment IT and the corresponding relays of the other trunks in the group constitute a sequence control whereby the operator's telephone is automatically connected to one waiting trunk at a time in the order in which the trunks are numbered. As shown in the drawings the trunk equipment IT is the last in the group. For a complete description of the operation of the sequence control, reference may be had to the aforementioned Fowler Patent 1,629,099. Assuming the operator to be idle at the time trunk T1 is seized and relay 29 operates, a circuit is closed from battery through the winding of relay 30, front contact of relay 29 and back contacts of the corresponding sequence relays of each of the other trunks in the group, to ground at the operator's position. Relay 30 is operated by the current in this circuit. At its lower front contacts, relay 30 connects the conductors of trunk T1, over conductors 31 and 32, to the operator's position equipment; and at its inner upper front contact connects the guard lamp and resistor 26, over conductor 33, through the winding of pilot relay 38, to the winding of relay 40. Relays 38 and 40 operate; the operation of relay 38 lights the position pilot lamp, and the operation of relay 40 causes the successive operation of relays 41 and 42. The operation of relay 42 short-circuits the winding of relay 40 thereby shunting and extinguishing the trunk guard lamp. The release of relay 40 causes the release of relays 41 and 42 and the release of relay 42 opens the short circuit around the winding of relay 40. Relays 40, 41 and 42 are thus successively operated and released to flash the trunk guard lamp to indicate to the operator the particular one of the trunks to which her telephone set is connected. The aforementioned operation of relay 30 also closes a circuit from battery through the lower front contact of relay 28, lower winding and inner back contact of relay 27, uppermost front contact of relay 30, over conductor 34 to the operator's position, and through windings of relays 43 and 44 to ground. The current in this circuit is ineffective to operate relays 27 and 43, both of these relays being marginal; but relay 44 is operated and closes a circuit for operating a group of tone control relays, relay 45 being the first and relay 46 the last relay of this group. The operation of relay 45, and the succeeding relays (not shown) of this group, causes the transmission of three impulses of tone current from the tone source 47 through the back contacts of relay 46, over conductors 31 and 32, and over trunk T1, through repeating coil 18 of trunk equipment OT—1 to the operator in office X. The operation of relay 46 at the end of the last of the three impulses completes a connection between the operator in office X and the operator in tandem office Y. The tone having ceased, the operator in office X passes the office name to the tandem operator. The tandem operator thereupon inserts the plug 25 in an idle jack in the group connected to trunks leading to the called office. The jack 30 represents a group connected to trunks leading to a manual office,

and jack 81 represents a group leading to an automatic office. The usual operator's busy test circuit is traced from the sleeve of the outgoing trunk jack, through the tip of plug 25, inner upper back contact of relay 24, conductor 36, back contact of relay 66 of the operator's key control apparatus, back contact of relay 48, through the busy-test coil 50 of the operator's telephone set. If plug 25 is inserted in jack 80, a circuit is also closed from battery through both windings of relay 48 in the operator's position equipment, over conductor 37, lower back contact and winding of relay 24 of trunk equipment IT, sleeve conductors of plug 25 and jack 80 to ground. The current in this circuit is effective to operate relay 48 but ineffective to operate the marginal relay 24. Relay 48 opens the busy-test circuit and connects the winding of relay 49 across the tip and ring of the plug 25 so that when the plug is fully seated relay 49 may operate in a series circuit over the tip and ring conductors of the seized outgoing trunk. Relay 49, operated, short-circuits the high resistance lower winding of relay 48, thereby causing the operation of sleeve relay 24. Relay 24 then locks over the sleeve, causes the release of relays 48 and 49, and closes a circuit for operating relays 22 and 27. This circuit is traced from battery through the lower front contacts of relay 24, upper winding of relay 27 in parallel with the winding of relay 22, to ground at the upper back contact of relay 23. At its inner front contacts, relay 22 completes the connection from trunk T1, through the windings of relay 21 in parallel with condensers 20, to the tip and ring conductors of plug 25. The operation of relay 22 also extinguishes the guard lamp of trunk IT and the operation of relay 27 causes the release of relay 29. Relays 21 and 28 remain operated until the connection is released. When cord C is disconnected from jack 15 in office X, the release of relay 17 in outgoing trunk equipment OT-1 causes the release of relays 21 and 28. The release of relay 28 closes the circuit for operating the disconnect signal relay 23. Relay 23 locks through its inner upper front contact, causes the release of relays 22 and 27, and lights the guard lamp as a disconnect signal. When the tandem operator removes the plug 25 from jack 80, relays 24 and 23 release in succession, thus restoring the trunk equipment IT to normal.

If the called office is a panel office, and the plug 25 is connected to jack 81, the circuit for operating relay 48 of the operator's position equipment is traced from battery through the windings of this relay, conductor 37, lower back contact and winding of sleeve relay 24, sleeve conductors of plug 25 and jack 81, upper back contact of relay 84 of trunk equipment OT-2, winding of relay 85, and winding of relay 86 to ground. Relays 48 and 85 are operated by the current in this circuit but relays 24 and 86 are marginal and do not operate at this time. Relay 48 opens the busy test path and connects the winding of relay 49 to the tip and ring of the plug 25 but relay 49 is not operated. Relay 85 closes an obvious circuit for operating relay 87 and relay 87 closes a circuit from ground at the inner lower back contact of relay 83, through the lower back contact of relay 88, lowermost front contact of relay 87, over conductor 100 to operate group relay 400 and thereby initiate the operation of an idle link to effect connection of an idle register sender with the trunk equipment OT-2, as described in detail in the aforementioned Carpenter et al. patent. When the trunk-hunting switch (not shown) of the link

engages the terminals to which the conductors 101, 102, 103, 104, 105 and 106 are connected a circuit is closed from battery through the winding of relay 89, inner lower front contact of relay 87, upper back contact of relay 88, lowermost back contact of relay 83, over conductor 105, test terminal and test brush of the trunk hunting switch (not shown) through the front contact of relay 525 and the windings of relays 511 and 502 in the link. The trunk-hunting operation of the link is stopped by relays 502 and 511. In operating, relay 89 closes at its lowermost front contact a holding circuit over conductor 105; and, at its inner lower front contact, a circuit for operating relay 88. Relay 88 locks through its inner upper front contact under the sole control of relay 87, disconnects ground from conductor 100 to allow group relay 400 to release, and at its upper back contact opens the operating circuit of relay 89. The link completes the connection between the trunk equipment OT-2 and an idle register sender in the manner set forth in the aforementioned Carpenter et al. patent.

At the same time as the plug 25 was inserted in jack 81, the operator in the tandem office depresses the non-locking key KP to effect the association of the numerical key set and control apparatus with the plug 25. Operation of key KP closes a circuit through the winding of relay 66 of the key control apparatus and resistor 65. Relay 66 is operated by the current in this circuit and locks through its lower front contact to ground at the key release key KR. Relay 66 opens the busy test circuit over conductor 36 from the tip of plug 25 and closes obvious circuits for operating relays 67 and 72. Relay 72 closes a circuit for lighting the key pulsing signal lamp 73, opens the operating circuit of relay 66, and connects ground over conductor 75 to the numerical keys. With relay 67 of the key control apparatus operated, and with a register sender connected to trunk equipment OT-2, a circuit is closed from battery through resistor 71, the inner lower back contact of relay 68, front contact of relay 67, over conductor 35, uppermost back contact of relay 24 of trunk equipment IT, ring conductors of plug 25 and jack 81, inner upper back contact of relay 83 of trunk equipment OT-2, outer left back contact of relay 90, conductor 102, through the link, conductor 529, inner back contact of relay 805 of the register sender, inner lower back contact and winding of relay 612, lower back contacts of relays 805, 807 and 808 to ground. Relay 612 of the register sender, operated by the current in this circuit, locks through its inner lower front contact and transfers the connection from conductors 102 and 529, through the windings of relays 616, 615 and 614 in series to battery. Relay 612 also closes a circuit from battery through the windings of relays 617, 618 and 619 in series, upper front contact of relay 612, uppermost back contact of relay 805, conductor 810, through the link and over conductor 101, inner left back contact of relay 90, uppermost back contact of relay 83, tip conductors of jack 81 and plug 25, inner upper back contact of relay 24, conductor 36, uppermost front contact of relay 66, continuity contact and winding of relay 70, to ground at the inner upper front contact of relay 66. Relay 70 is operated by the current in this circuit and it locks through resistor 71 in local circuit. Relay 70 closes a circuit from battery through the winding of relay 68, and from battery through lamp 74 and the lowermost back contact of relay 69, through the lower front contact of relay 70

and inner lower back contact of relay 69, to ground at the inner upper front contact of relay 66. Lamp 74 lights to indicate to the operator that a register sender has been attached to trunk equipment OT—2 and is ready to register the number of the called subscriber's line. At its upper front contact, relay 68 completes a connection from the key pulsing conductor 36 to the numerical keys and through the winding of polarized relay 61 to 24 volt battery; at its inner lower front contact, relay 68 completes a connection from the key pulsing conductor 35 to the numerical keys and through the winding of polarized relay 62 to 24 volt battery; and at its lowermost front contact, relay 68 connects 48 volt battery through resistor 55 to the numerical keys.

The aforementioned depression of the KP key was also effective to cause the transmission of two impulses of tone over trunk T1 to the "A" operator in office X in the same manner that three impulses were transmitted; and in response to these two tone impulses, the "A" operator passes the number of the called line with which connection is desired. Depression of the numerical keys, by the tandem operator, in accordance with the various digits of the called subscriber's number is effective in the manner described in the aforementioned Carpenter et al. patent to transmit various combinations of impulses from the key-set over conductors 35 and 36 and conductors 101 and 102 to cause the operation of various combinations of relays 614, 615 and 616 and relays 617, 618 and 619 in the register sender. These combinations are such as will cause the operation of the one or the other but not both of the polarized relays 61 and 62 at the same time. When the thousands, hundreds, tens and units digits of the called subscriber's number have all been registered, relay 805 in the register sender is operated in the manner described in the aforementioned Carpenter et al. patent thereby connecting 48 volt battery through the windings of relays 807 and 808 to conductors 101 and 102 to cause the operation of both of the polarized relays 61 and 62 and thereby close a circuit for operating relay 63. Relays 807 and 808, being marginal, are not operated at this time. Relay 63 locks through its lowermost front contact and connects ground through both lower front contacts to the winding of relay 61 and conductor 36 thereby increasing the current through the winding of relay 808 in the register sender to cause the operation of relay 808. Relay 808 locks to ground through the upper back contact of relay 807 and causes the release of relay 805, as described in the aforementioned Carpenter et al. patent, thereby causing the release of polarized relay 62 and the operation of relay 64 of the key control apparatus. Relay 64 short-circuits the winding of relay 66 thereby causing the release of relays 66, 67, 70 and 72. The release of relays 66 and 67 disconnects the key-set from conductors 35 and 36 and causes the release of relays 63 and 64.

The aforementioned operation of relay 64 was also effective at its uppermost front contact to connect 24 volt battery to conductor 37 to cause the operation of relay 24 in trunk equipment IT and the operation of the marginal relay 86 in trunk equipment OT—2. At its lower front contacts relay 24 closes its locking circuit over the sleeve conductors of plug 25 and jack 81 and the circuits for operating relays 22 and 27 as hereinbefore described. Relay 27 locks through its

lower winding under control of relay 28 and causes the release of relays 29 and 30. The aforementioned operation of marginal relay 86 of trunk equipment OT—2 causes the successive operation of relays 82 and 83. Relay 83 connects the upper winding of relay 82 in parallel with the winding of relay 86 to reduce the resistance in the sleeve conductor so that, in case an operator overrides the busy test and inserts the plug of some other incoming trunk into another of the jacks to which the trunk equipment OT—2 is connected, the sleeve relay of this other incoming trunk will operate. Relay 83 also disconnects the key pulsing conductors 101 and 102 from jack 81; and, relay 24 having been operated, completes a circuit for holding the line relay 21 of incoming trunk equipment IT operated, while the register sender is controlling the operations of the incoming and final selector switches in the distant panel office. This circuit is traced from battery through resistor 96 and the outer right back contact of relay 90 of trunk equipment OT—2, lowermost back contact of relay 99, conductor 98, inner upper front contact of relay 83, ring conductors of jack 81 and plug 25, upper front contact of relay 24, uppermost back contact of relay 23, inner lower front contact of relay 22, lower winding of relay 21, lower conductor of trunk T1, contact of relay 17, lower right winding of repeating coil 18 of trunk equipment OT—1, winding of polarized relay 19, upper right winding of repeating coil 18, upper conductor of trunk T1, upper winding of relay 21, upper front contacts of relay 22, tip conductors of plug 25 and jack 81, uppermost front contact of relay 83, conductor 97, inner lower back contact of relay 99, inner right back contact of relay 90, and through resistor 95 to ground. The current in this circuit is effective to hold relay 21 operated but is not effective to operate polarized relay 19 in office X. Over conductors 627 and 531 and conductors 103 and 104, the register-sender controls the operation of the incoming and final selector switches IS and FS in the distant panel office in the manner described in the aforementioned Carpenter et al. and Berry patents. When final selections have been completed, the operation of relay 604 of the register sender opens the short circuit around the right winding of relay 602 thereby causing the release of relay 525 of the link and the opening of the circuit over conductor 105 so as to cause the release of relay 89 of trunk equipment OT—2. At its uppermost back contact relay 89 connects resistor 92 across conductors 103 and 104 to temporarily hold the supervisory relay 201 of the incoming selector IS operated. Relay 89 also closes a circuit from battery through the winding of relay 99, uppermost front contact of relay 88, inner upper back contact of relay 89, to ground at the inner upper front contact of relay 87. Relay 99 operates, thereby disconnecting conductors 97 and 98 from resistors 95 and 96 and transferring the conductors of trunk T2 from conductors 103 and 104 to conductors 97 and 98 so that relay 201 of the incoming selector IS is now held operated in a circuit which includes the conductors of trunk T2, the windings of relay 21 of trunk equipment IT, the conductors of trunk T1 and the winding of the polarized relay 19 of trunk equipment OT—1. The link and register sender are returned to normal, the incoming selector closes a ringing circuit over the called subscriber's line and, upon answer at the called subscriber's station, the supervisory relay 202 is operated to reverse the connections between the

conductors of trunk T2 and the windings of relay 201. The reversal of current over trunks T2 and T1 is effective to cause the operation of polarized relay 19. At its front contact, relay 19 short-circuits the upper winding of relay 16 thereby causing the operation of the calling cord supervisory relay 13. Relay 13, extinguishes the lamp 14 to indicate to the "A" operator in office X that the called subscriber has answered. The talking circuit includes the repeating coil of cord C, the repeating coil 18 of trunk equipment OT-1, condensers 20 of trunk equipment IT, and the repeating coil (not shown) of the incoming selector IS.

When conversation is completed and the "A" operator disconnects cord C from jack 15, relays 16 and 17 release. The release of relay 17 opens the circuit over trunks T1 and T2 thereby releasing relays 19, 21 and 201. The release of relay 201 causes the return of selectors IS and FS to normal in usual manner. The release of relay 21 causes the successive release of relay 23, operation of relay 23, and release of relays 22 and 27. Relay 23 locks under the sole control of relay 24 and closes the circuit for lighting the guard lamp as a disconnect signal. When the tandem operator disconnects plug 25 from jack 81, relays 24, 85 and 86 all release. The release of relay 24 causes the release of relay 23 thereby extinguishing the guard lamp, trunk equipment IT being ready for use on another call. The release of relay 85 causes the release of relay 87 and the release of relay 86 causes the successive release of relays 82 and 83. The release of relay 87 causes the release of relays 88 and 99, the trunk equipment OT-2 thus being ready for use on another call.

If the operator in the tandem office wishes to free her position equipment from an incoming trunk IT to which it is connected, the depression of the position release key R is effective to connect ground to conductor 34 and thus energize the lower winding of relay 27. Relay 27 operates and locks under the sole control of relay 28. The operation of relay 27 causes the release of relays 29 and 30.

If the tandem operator starts keying the called number before the register sender is attached, relay 69 operates, locks under control of relay 66, and connects interrupter 76 to lamp 74 to flash this lamp as a warning signal. If the incoming selector advances to the overflow position, or if the tandem operator fails to key four digits and the incoming or final selector is advanced under the control of the register sender to "tell-tale" position, the register sender short-circuits both the middle and right windings of relay 602 thereby causing the operation of relay 524 in the link. Relay 524 thereupon connects conductor 106 to a source of interrupted ground potential to cause the alternate release and reoperation of relay 90 of trunk equipment OT-2. The operation of relay 90 causes the key pulsing conductors 35 and 36 to be disconnected from conductors 101 and 102 and connects the key pulsing conductors through resistors 94 to battery, thereby causing both of the polarized relays 61 and 62 of the key control apparatus to operate and thereby initiate the disconnection of the key set from the trunk equipment IT as heretofore described. With relays 24 and 83 operated, each operation of relay 90 causes the reversal of current through the winding of polarized relay 19 thereby causing the intermittent short-circuiting of the upper winding of relay 16 and the consequent flashing

of the calling cord supervisory lamp 14 in office X. To correct an error in keying, the tandem operator may disconnect plug 25 from jack 81 and, if all four digits of the called number have not been keyed, the key release key KR is operated to restore the key control apparatus to normal. Plug 25 is then connected to an idle trunk, the KP key is again operated and the number correctly keyed. If the tandem operator disconnects plug 25 from jack 81 prematurely, relays 85, 87 and 88 release. Relay 87 closes a circuit from ground through the winding of relay 84, upper back contact of relay 27, over conductor 106, through the back contact of relay 524 in the link to battery. Relay 84 operates and connects a busy potential to the sleeve conductor of jack 81 until the sender and link disconnect the ground potential from conductor 105, at which time relay 89 releases; and, when relay 525 operates, the disconnection of battery potential from conductor 106 causes the release of relay 84, the equipment OT-2 then being normal awaiting use on another call.

What is claimed is:

1. In a telephone system, subscribers' lines, a manual office, a tandem office, an automatic office, an operator's position equipment in said tandem office, said equipment including a telephone set and a numerical impulse sender, a trunk incoming from said manual office to said position, a line relay for operation upon seizure of said trunk in the manual office, means responsive to the operation of said line relay for connecting said incoming trunk to said operator's telephone set, a trunk outgoing from said position to said automatic office, a register controller in said tandem office for use in completing calls to lines in said automatic office, means for operatively connecting said numerical impulse sender to said register controller and for connecting said controller to said outgoing trunk, means effective upon completion of the transmission and registration of impulses corresponding to a called subscriber's number for operatively disconnecting said incoming trunk from said position equipment, means individual to said outgoing trunk for holding operated the line relay of said incoming trunk after disconnection of the incoming trunk from said position equipment, and means effective upon connection of said outgoing trunk with the called line in the automatic office for operatively disconnecting said register controller and for completing a talking connection over said incoming and outgoing trunks.

2. In a multioffice telephone system, subscribers' lines, an operator's position comprising a telephone set and a numerical key-set, a plug-ended trunk incoming to said position, an automatic office, a jack-ended trunk outgoing from said position to said automatic office, a line relay for said incoming trunk, means responsive to the operation of said line relay for connecting said incoming trunk to said telephone set, a key, the operation of said key being effective to connect said numerical key-set to said incoming trunk, a register sender for registering the number of a called line upon operation of the corresponding keys of said numerical key-set and for controlling the completion of a connection to the called line in said automatic office, means responsive to the connection of said incoming trunk with said outgoing trunk for connecting said register sender to said outgoing trunk, means associated with said key-set for indicating to said operator the connection of said register sender and for rendering

the numerical key-set operatively effective to control said register sender, means operated upon registration of the required number of digits in said register sender for disconnecting said operator's telephone set and key-set from said incoming trunk, means in said outgoing trunk for holding operated the line relay of said incoming trunk after disconnection of said operator's equipment while said register sender is controlling the establishment of a connection with the called line in the automatic office, and means in said automatic office for holding said line relay upon disconnection of said register sender from said outgoing trunk.

3. In a telephone system, subscribers' lines, an operator's position comprising a telephone set and a numerical key-set, an incoming trunk and an outgoing trunk terminating at said position, means comprising a line relay operative upon seizure of the outgoing end of said incoming trunk for connecting the talking conductors of said incoming trunk to said operator's telephone set, manually controlled means for interconnecting said trunks, manually controlled means for operatively associating said key-set with said outgoing trunk, means comprising a selector switch connected to the distant end of said outgoing trunk for establishing connection with a called subscriber's line, a register sender for registering the number of a called line and for controlling the operation of said selector switch, means responsive to the interconnection of said trunks for connecting said register sender to said outgoing trunk, a source of current in said outgoing trunk, means responsive to the keying of a subscriber's number and registration of the keyed digits in said register sender for disconnecting said incoming trunk from said operator's position and for connecting the talking conductors of said incoming trunk to said source of current to hold said line relay operated, means effective upon establishment of connection with the called line for disconnecting said register sender and for completing the talking connection over said incoming and outgoing trunks, and means in said selector for holding said line relay operated.

4. In a telephone system, subscribers' lines, an operator's position comprising a telephone set and

a numerical key-set, an incoming trunk and an outgoing trunk terminating at said position, means comprising a line relay individual to the incoming trunk for connecting said incoming trunk to said operator's telephone set, means for interconnecting said trunks, means comprising said key-set, a register sender and a selector connected to the distant end of said outgoing trunk for establishing connection with a called subscriber's line, means for operatively associating said key-set with said outgoing trunk, means for thereupon operatively associating said register sender with said outgoing trunk for registration of the digits of the called line number as indicated by operation of said numerical keys, and means effective upon completion of registration of the called number for disconnecting said position equipment and for holding said line relay operated while said register sender is controlling the completion of connection with the called line.

5. In a telephone system, subscribers' lines, an operator's position comprising a telephone set and a numerical key-set, an incoming trunk and an outgoing trunk terminating at said position, means comprising a line-relay individual to the incoming trunk for connecting said incoming trunk to said operator's telephone set, means at said position for interconnecting said trunks, means including said interconnecting means for operatively associating said key-set with said outgoing trunk, means comprising said key-set, a register sender and a selector connected to the distant end of said outgoing trunk for establishing connection with a called subscriber's line, means for operatively associating said register sender with said outgoing trunk for registration of the digits of the number of the called line as indicated by operation of said numerical key-set, and means effective upon completion of registration of the called number for disconnecting said position equipment and for holding said line relay operated while said register sender is controlling the completion of the connection with the called line.

6. In a telephone system according to claim 5, means including said line relay for opening the talking connection over said incoming trunk.

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