

July 24, 1928.

1,678,103

H. C. CAVERLY

TELEPHONE SYSTEM

Filed Oct. 4, 1927

4 Sheets-Sheet 1

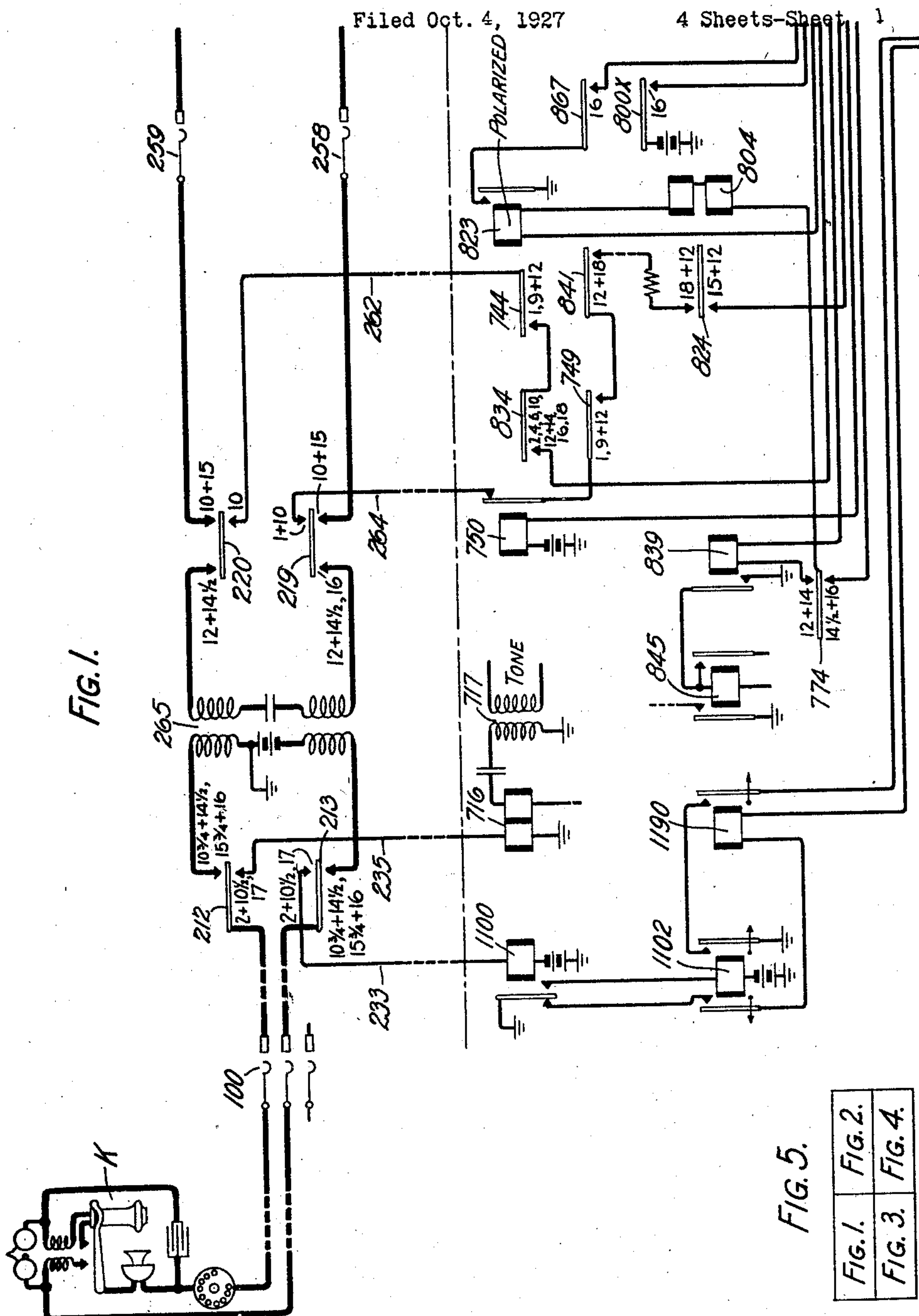


FIG. 5.

FIG. 1.	FIG. 2.
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FIG. 3.

INVENTOR:

HARRY C. CAVERLY

BY

P. C. Smith

ATTORNEY

July 24, 1928.

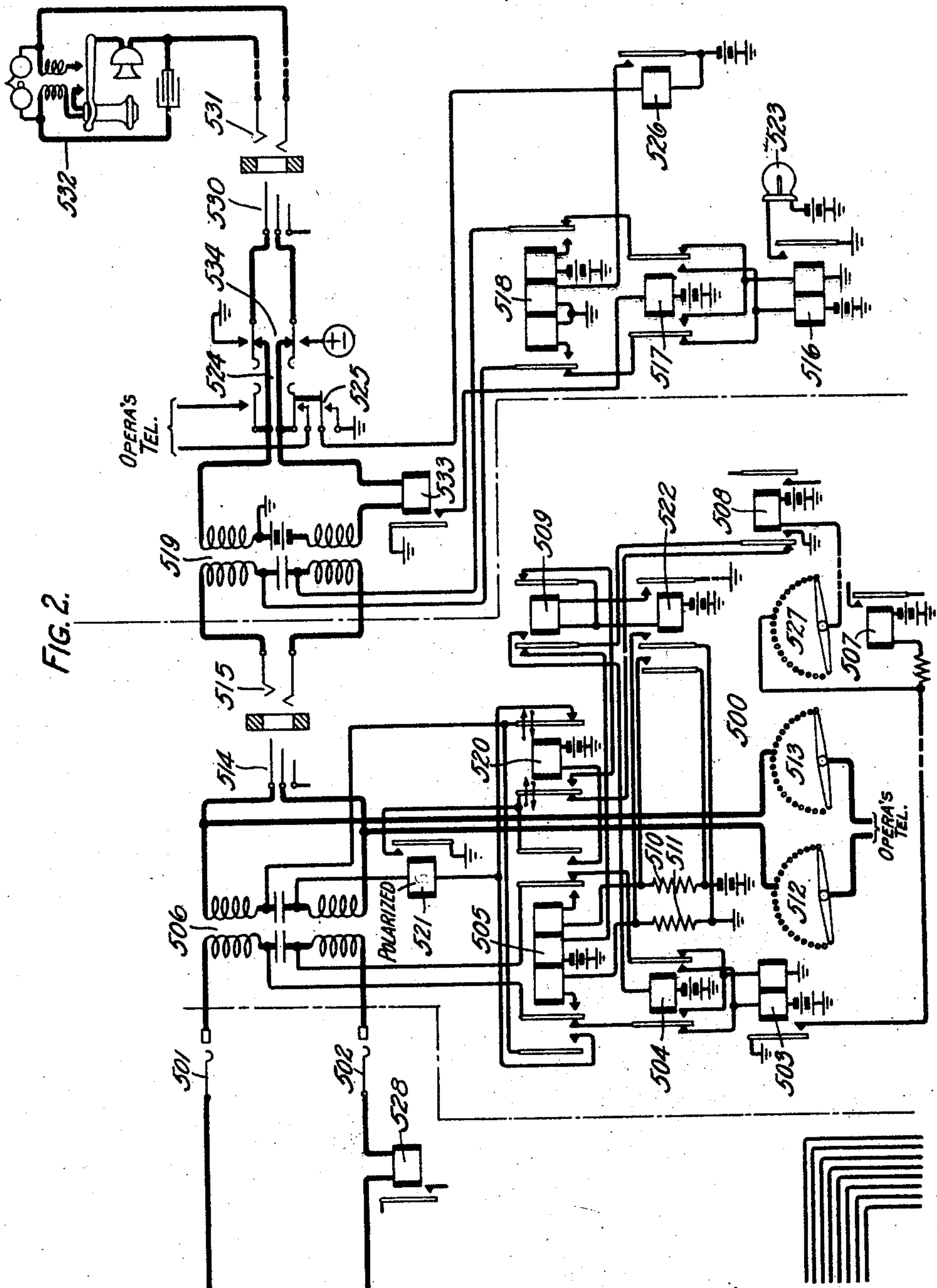
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H. C. CAVERLY

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4 Sheets-Sheet 2



INVENTOR:
HARRY C. CAVERLY
By *P. C. Smith*
ATTORNEY

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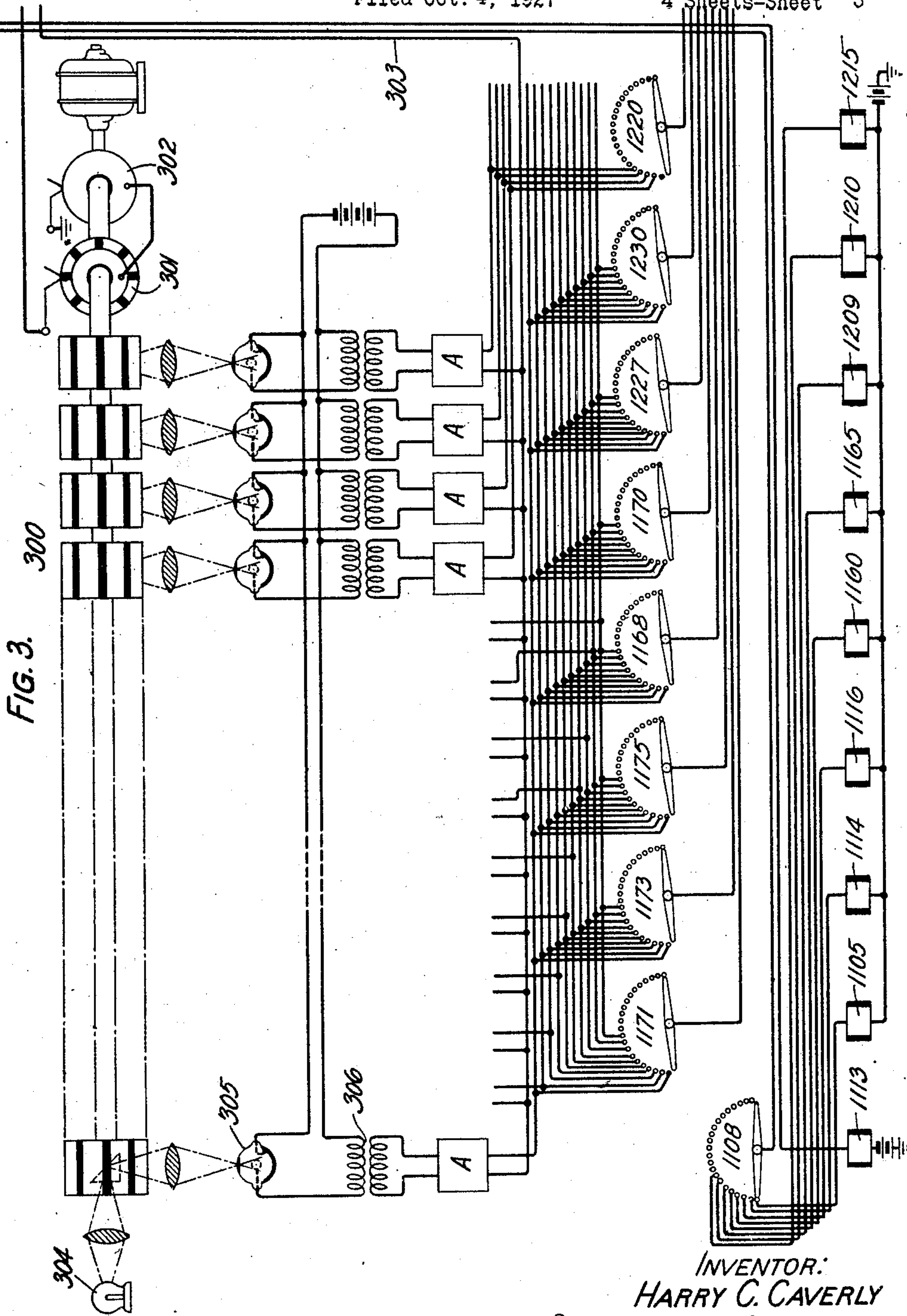
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H. C. CAVERLY

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4 Sheets-Sheet 3



INVENTOR:
HARRY C. CAVERLY
By *P. C. Smith*
ATTORNEY

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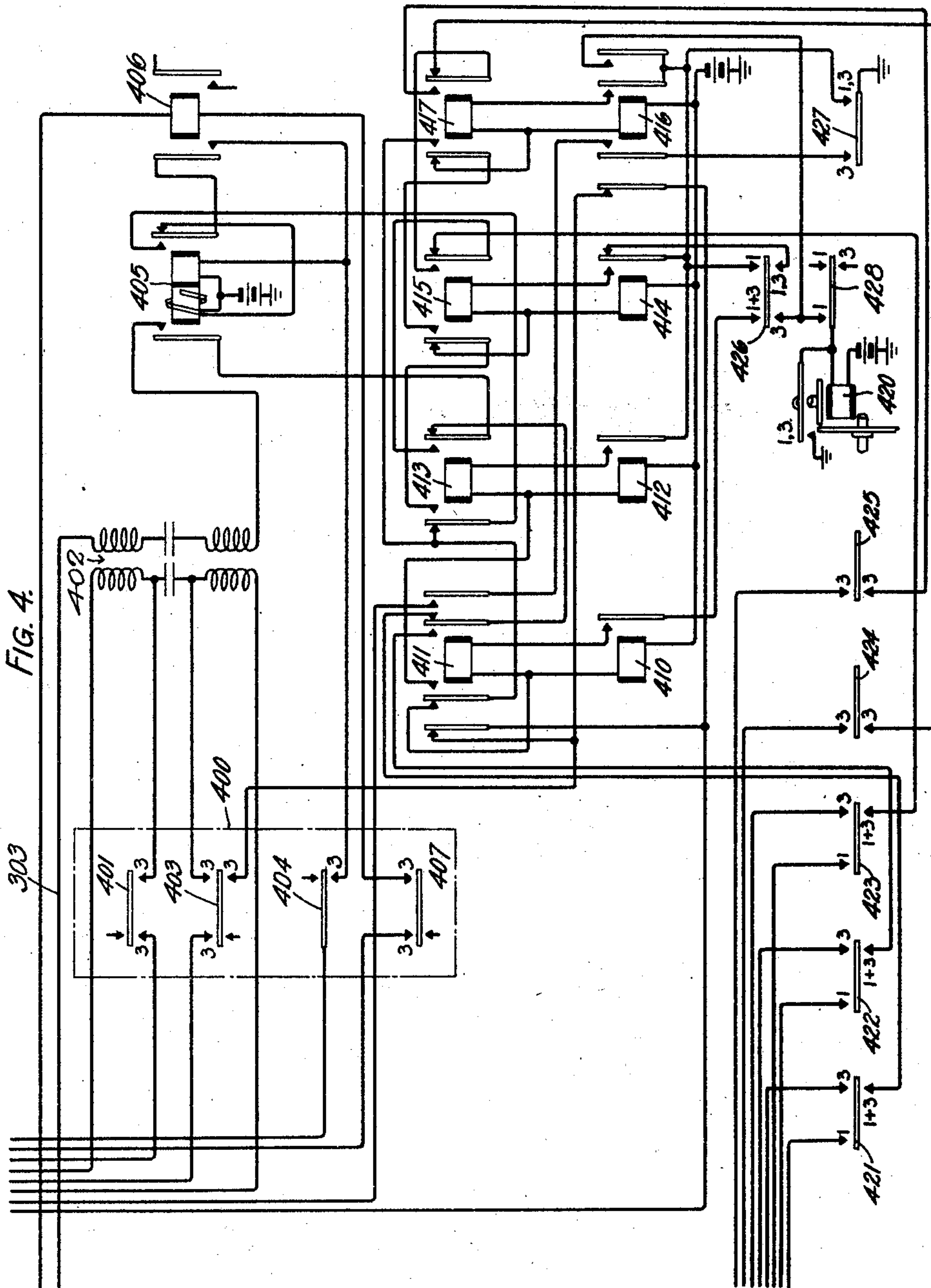
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H. C. CAVERLY

TELEPHONE SYSTEM

Filed Oct. 4, 1927

4 Sheets-Sheet 4



INVENTOR:
HARRY C. CAVERLY
By *P. C. Smith*
ATTORNEY

UNITED STATES PATENT OFFICE.

HARRY C. CAVERLY, OF EAST ORANGE, NEW JERSEY, ASSIGNOR TO BELL TELEPHONE LABORATORIES, INCORPORATED, OF NEW YORK, N. Y., A CORPORATION OF NEW YORK.

TELEPHONE SYSTEM.

Application filed October 4, 1927. Serial No. 223,880.

This invention relates to telephone exchange systems and has for its object the provision of improved means for automatically transmitting telephone designations from one office to another, particularly where an intermediate or a tandem office is employed, whereby the establishment of such connections is simplified and rendered less subject to error.

Where a telephone connection has been extended from a machine switching office to a manual office through a tandem office in the past, it has been customary to transmit the complete telephone designation to the tandem office, where the tandem operator selects an outgoing trunk and passes the called line number to the distant office, or where a tandem sender records the designation, employs the office code to select a trunk, and retransmits the called line number to the distant office.

In accordance with the present invention, only the office code is transmitted to the tandem office and the extension of the inter-office trunk to the distant office causes the transmission of the line number to such distant office. This obviates the necessity of repeating the called line number either orally or mechanically and therefore lessens the chance of error due to such repetition.

The invention finds one specific embodiment in a system in which the telephone designations are transmitted by means of a call announcer mechanism located at an automatic office to a tandem operator and subsequently to a distant operator. A series of counting relays associate the call announcer mechanism with the registers of the sender to cause the transmission, certain of the series being employed for the announcement of the office code and re-used to subsequently announce the called line number.

This specific embodiment is illustrated in the accompanying drawings in which Fig. 1 shows a calling subscriber's line in a mechanical office and portions of a district selector and sender for extending a connection and controlling such extension. Fig. 2 shows a schematic office selector, a portion of a tandem office, a portion of a manual office, and a subscriber's line at the manual office. Fig. 3 shows a part of the sender registers and a mechanism for making call announcements. Fig. 4 shows a por-

tion of a class switch and counting relays for controlling the association of the call announcer with the talking connection. Fig. 5 shows the manner in which Figs. 1 to 4 should be arranged.

These drawings indicate the application of the present invention to such a system as that disclosed in U. S. Patent 1,505,171, granted to F. A. Stearn August 19, 1924. It is, of course, to be understood that the invention is also applicable to other systems. Reference is made to the above mentioned patent for a description of the operations omitted from the present discussion and for convenience in so doing the same numbers have been applied to such parts taken from the above disclosure as are used therein. No numbers in the third, fourth or fifth hundreds have been taken from the Stearn disclosure. Therefore, the new portions of Fig. 3 will be given numbers in the third hundred, those of Fig. 4 in the fourth hundred and those of Fig. 2 in the fifth hundred and it will be understood that all numbers in these hundreds refer exclusively to the present disclosure. Fig. 2 is divided into three sections by dotted lines, the left section representing a two wire office selector which may be located at an intermediate office, the middle section representing the tandem office and the right section the manual office. For a description of a two wire office selector reference is made to U. S. Patent 1,567,271 to L. H. Johnson, December 29, 1925.

The initiation of a call by the subscriber at substation K causes the line switch to hunt for an idle district selector and to extend the line thereto. An idle sender is then attached to the district selector whereupon a tone is transmitted to the calling subscriber from tone coil 717. Relay 1100 also operates over the subscriber's line in turn operating relay 1102. The subscriber then manipulates his dial, to register the number of a wanted subscriber, whose telephone it will be assumed is located at a manual office, reached from the calling subscriber's office through a tandem office. Relay 1100 is released at each interruption of the line circuit by the dial, closing a circuit from ground, over the back contact of relay 1100, front contact of relay 1102, which remains operated due to its slow release character,

winding of relay 1190, brush 1108 of the register control switch in its normal position, winding of magnet 1105 of the first office code register to battery. This register is advanced one step for each interruption of the line circuit and brush 1171 comes to rest on the terminal corresponding to the first digit of the office code. Relay 1190 is operated in the circuit of magnet 1105 and, being slow to release, remains operated between interruptions of its circuit. Relay 1190 in operating completes a circuit from ground, over the right front contact of relay 1102, contact of relay 1190, through the winding of magnet 1113 of the register control switch, to battery. Between digits relay 1190 releases, permitting magnet 1113 to advance the register control switch to connect with the next register. Brush 1173 of the second office code register, brush 1175 of the third code register, brush 1168 of the thousands register, brush 1171 of the hundreds register, brush 1227 of the tens register, brush 1230 of the units register and brush 1220 of the stations register are successively positioned in a similar manner. Following the completion of registration the translator (not shown) is positioned from the three office code registers and the class switch represented by the rectangle 400 is set in a position indicating that the call is to be a tandem call and the designation is to be transmitted by call announcer. This position has been assumed to be position 3, which was a spare position in the Stearn patent.

The sender then proceeds to control the setting of the district selector indicated by brushes 259 and 258, and the office selector indicated by brushes 501 and 502, in the manner described in the Stearn patent. When the office selector has been positioned a test is made of the condition of the inter-office trunk. The circuit for this purpose may be traced from battery, through the left winding of relay 503 at the tandem office, left back contact of relay 504, left back contact of relay 505, upper left winding of repeating coil 506, office selector brush 501, district selector brush 259, right contacts of cam 220, conductor 262 and other intervening apparatus, cam 744 of the sender control sequence switch which is now standing in position 9, cam 834 of the sender sequence switch which is now in position 12, upper left winding of repeating coil 402, cam 401 of the class sequence switch, through the winding of polarized relay 823, winding of stepping relay 804, upper contact of sender cam 774, winding of relay 839, upper contacts of cam 403, lower left winding of repeating coil 402, contacts of cam 824, through a compensating resistance, contact of cam 841, contact of cam 749, back contact of relay 750, right contacts of cam 219,

brush 258, winding of relay 528 at the office selector, brush 502, lower left winding of repeating coil 506, right back contacts of relays 505 and 504, right winding of relay 503 to ground. Relay 839 operates and advances the sender sequence switch to position 14 from which it is advanced to position 16 in the manner described in the Stearn patent. The current is not in the right direction to operate relay 823. Relay 503 also does not operate in this circuit due to the high resistance of relay 839. When the sender sequence switch reaches position 16, the circuit above traced extends over the lower contact of cam 774, outer left back contact of relay 411, and in parallel over the outer left back contact of relay 416, right contacts of cam 403, lower left winding of repeating coil 402 and thence as previously traced, omitting relay 839 from the circuit. Relay 503 now operates to indicate to the tandem operator that a call is incoming to her position. While this relay may function in any desirable manner to signal the operator, an automatic arrangement of the sort disclosed in application Serial No. 213,506, filed August 17, 1927, in the name of W. A. Rhodes et al. has been shown by way of example.

The operation of relay 503 operates relay 507 which starts switch 500 hunting for the trunk and also marks the trunk in the arc 527 of that switch. When the switch connects with the trunk, a circuit is completed for relay 508 which stops the switch and performs any other necessary functions. It also completes a circuit from ground at its left front contact, left back contact of relay 509, middle winding of relay 505 to battery. Relay 505 operates in this circuit and locks through its outer windings to the trunk circuit thus completing a circuit from battery, through resistance 510, right winding and inner right armature of relay 505, to the lower left winding of repeating coil 506 and the ring conductor of the trunk extending as before traced back over the tip conductor of the trunk to the upper left winding of repeating coil 506, left armature and winding of relay 505, resistance 511, to ground. Relay 508 is released by means not shown after a short time so that the continued operation of relay 505 is dependent upon the sender. The operation of relay 505 opens the circuit of relay 503 and that relay releases but switch 500 is held by other means. The current in the locking circuit of relay 505 is in the reverse direction to that formerly flowing through the windings of relay 503 and therefore relay 823 operates in this circuit. Relay 823 in operating closes a circuit from ground at its front contact, contact of cam 867, contact of cam 404, right winding of relay 405, to battery, for initiating the call announcement. However, a shunt may be

closed around the winding of relay 405 extending from battery, through the left non-inductive winding of the relay, over the right back contact thereof, over the front contact of relay 406 to the operating circuit of relay 405. Relay 406 is operated in a circuit from battery, over cam 800X belonging to the sender sequence switch, class cam 407, winding of relay 406, to ground through commutators 301 and 302 carried by the call announcer mechanism. The conducting and insulating segments of commutator 301 are so arranged that relay 406 is operated while the talking portions of the announcing drums are effective and released during the silent periods. Therefore, if the circuit of relay 405 is completed at a time which would correspond to the middle of a word it cannot operate, thus preventing the mutilation of a signal. When relay 406 releases at a silent period, relay 405 operates completing the primary circuit of the repeating coil 402 which may be traced from the common conductor 303, through the right windings of the repeating coil, left front contact of relay 405, right back contact of relay 413, right back contact of relay 411, lower right and upper left contacts of cam 421, belonging to the call announcer sequence switch 420, brush 1171 of the first office code register in its set position, through the connected amplifier and transformer, back to the common conductor 303.

The call announcer mechanism shown illustrates one form which such a mechanism may take. It comprises a series of drums having opaque and partially transparent sections, the partially transparent sections being photographic records of the sounds corresponding to the digits from 0 to 9 and the stations letters R, M, J and W. The light from a source such as lamp 304 may be directed by any suitable means through the speech record to a photoelectric cell such as 305 connected to one side of a transformer such as 306. The output currents from the transformer are amplified and transmitted to the repeating coil 402 over the circuit above traced, where they are inductively transmitted to the interoffice circuit above traced, and thereover to the operator at the tandem office. A call announcer mechanism such as disclosed in Patent No. 1,645,573, patented October 18, 1927, in the name of H. M. Bascom may also be employed. The register arcs are indicated as being those employed in the Stearn patent for controlling call indicator impulses. It is obvious that there might be employed for this purpose additional arcs on the register switches, or that the multiple connections to these arcs might be transferred from the call indicator equipment to the call announcer equipment by cams of the class sequence switch.

Relay 405 when operated as above de-

scribed also closes a circuit from battery, through the winding of relay 410, inner left back contact of relay 411, left back contact of relay 413, right front contact of relay 405, front contact of relay 406, to ground over the operating circuit of relay 405. Relay 410 operates in this circuit and closes a locking circuit for itself through the winding of relay 411, the front contact of relay 410, upper contacts of cam 426, right contact of cam 427, to ground. Relay 411 cannot operate at this time being shunted by the operating ground of relay 410. When relay 406 releases at the conclusion of the announcement of the first digit, relay 405 does not release since the shunt around its winding is now open. However, the shunt is removed from relay 411 and that relay operates in the locking circuit of relay 410. The operation of relay 411 extends the announcing circuit from the primary winding of coil 402 over the right back contact of relay 413, inner right front contact of relay 411, lower right and upper left contacts of cam 422, to brush 1173 of the second office code register. When relay 406 reoperates at the beginning of the next talking period a circuit is closed for relay 412 from battery, through the winding of that relay, left front contact of relay 411, left back contact of relay 413, to ground as previously traced. Relay 412 locks through the winding of relay 413 but relay 413 does not operate until the end of the talking period when relay 406 again releases. With relay 413 operated the announcing circuit extends over the right front contact of relay 413, right back contact of relay 415, lower right and upper left contacts of cam 423 to brush 1175 of the third office code register. The operation of relay 406 during the third talking period completes a circuit from battery, through the winding of relay 414, left back contact of relay 415, left front contact of relay 413, to the right front contact of relay 405 and thence to ground as traced. Relay 414 operates and locks through the winding of relay 415, but relay 415 does not operate until relay 406 releases at the end of the third talking period. The next operation of relay 406 directs the announcing circuit to cam 424 but no circuit is completed over that cam with switch 420 in position 1. The operation of relay 406 causes relay 416 to operate and lock.

Since relay 411 is operated at the time that relay 416 operates, the operation of the latter relay opens the circuit of relay 823 and that relay as well as relay 505 releases. Relay 416 also closes a circuit from ground over the upper contact of cam 427, outer right contact of relay 416, upper left contact of cam 428, winding of sequence switch magnet 420 to battery. The call announcer switch 420 is advanced to position

3. As switch 420 advances out of position 1 relays 410 and 417 release. With relay 505 released, and relays 411 and 416 released, the circuit of relay 823 is again extended to relay 503 but the operation of relay 503 is ineffective at this time.

The telephone set of the tandem operator was connected to the right winding of repeating coil 506 over brushes 512 and 513 as soon as switch 500 came to rest, therefore she is ready to receive the call announcement as soon as it is transmitted to her. When she hears the three digits which identify the office to which the call is to be extended, she selects an idle outgoing trunk to that office and inserts the plug 514 of the incoming trunk in the jack 515 of the outgoing trunk. The insertion of plug 514 in jack 515 completes a circuit from battery, through the left winding of relay 516, left back contacts of relays 517 and 518, upper left winding of repeating coil 519, over the tip of jack 515 and plug 514, upper right winding of repeating coil 506, over the right back contact of relay 520, winding of relay 521, lower right winding of repeating coil 506, rings of plug 514 and jack 515, lower left winding of repeating coil 519, right back contacts of relays 518 and 517, right winding of relay 516, to ground. Relay 516 operates in this circuit to indicate to the operator at the manual office that a call is incoming, but the current does not flow in the proper direction to operate the polarized relay 521. Although a lamp has been shown for this purpose together with manual listening and ringing keys, it is to be understood that automatic equipment similar to that shown at the tandem office might be employed, while manual equipment might be employed at both offices. Assuming the apparatus to be as shown, the operation of relay 516 lights lamp 523. In response to the lamp signal the operator closes her listening key 524 connecting her telephone to the trunk and also closing a circuit from ground, over the auxiliary contact 525, winding of relay 526, to battery. Relay 526 operates, closing a circuit from battery, over its front contact, middle winding of relay 518, to ground. Relay 518 operates in this circuit, locking through its outer windings to the circuit of relay 521. The operation of relay 518 reverses the current through the winding of relay 521 which now operates. Relay 521 in operating closes a circuit from ground at its front contact, left back contact of relay 520, back contact of relay 508, right back contact of relay 509, middle winding of relay 505, to battery. Relay 505 again locks through its outer windings to the circuit of relay 823, operating the latter relay. Relay 505 also closes a circuit from battery, through the winding of relay 520, outer right front con-

tact of relay 505, to ground at the front contact of relay 521. Relay 520 is slow to operate to insure that the circuit of relay 521 is closed at the outer left front contact of relay 505 before it is opened at the right contact of relay 520. Relay 520 closes a circuit from battery, through the winding of relay 522, back contact of relay 509, front contact of relay 520, front contact of relay 521, to ground. Relay 522 locks through the winding of relay 509 and its own front contact, to ground, but relay 509 cannot operate being shunted by the operating ground of relay 522. The operation of relay 522 closes shunts around resistances 510 and 511 increasing the current through relay 528 so that in combination with the reversed direction of the current, relay 528, which is both polarized and marginal, may operate. When the fundamental circuit is opened as described hereinafter, relay 528 releases to establish a talking circuit and otherwise alter the circuits at the office selector as set forth in the above mentioned Johnson patent.

The operation of relay 823 again operates relay 405 at the beginning of a talking period of the call announcer. The announcing circuit now extends over the right back contact of relay 413, right back contact of relay 411, right contacts of cam 421 to brush 1168 of the thousands register. The first operation and release of relay 406 caused relays 410 and 411 to operate and lock, the locking circuit extending over the upper left and lower right contacts of cam 426, the back contact of relay 414, to ground, at the right contact of cam 427. During the next talking period the announcing circuit extends over the right contacts of cam 422 to brush 1170 of the hundreds register and relays 412 and 413 operate and lock. During the next talking period the announcing circuit extends over the right contacts of cam 423 to brush 1227 of the tens register and relays 414 and 415 operate and lock. It will be noted that with switch 420 in position 3 the locking circuit of relays 410 and 411 extends over the lower right contact of cam 426 and the left back contact of relay 414, so that the operation of relay 414 releases relays 410 and 411. During the next period relays 416 and 417 are operated but since relay 411 is now released, the circuit of relay 823 is maintained closed. The announcement circuit extends during this period over the right front contacts of relays 413 and 415 and the right back contact of relay 417, contacts of cam 424, to brush 1230 of the units register. During the next period the operating circuit for the counting relays is extended over the front contact of relay 405, left front contact of relays 413, 415 and 417 and inner left back contact of relay 411, the winding of relay 410 and battery and relay 410 is

reoperated, locking in a circuit extending through the winding of relay 411, the right contact of relay 410, the left contact of cam 426, the outer right contact of relay 416 to ground at the right contact of cam 427. At this time the announcing circuit may be traced from the left front contact of relay 405, over the right front contacts of relays 413, 415 and 417 and the contacts of cam 425 to brush 1220 of the stations register. When relay 411 operates at the end of the fifth period, the circuit of relay 823 is opened releasing relays 823, 528 and 505. The operation of relay 411 also closes a circuit from ground, over the left contact of cam 427, left front contact of relay 416, outer right front contact of relay 411, through the winding of relay 750, to battery. The operation of relay 750 also opens the circuit of relay 823 and serves, as described in the above identified patent, to advance the sender to make talking selections, to establish the connection to the distant office and to release the sender. The restoration of the sender closes a circuit (not shown) for advancing sequence switch 420 to its next operating position. While only positions 1 and 3 have been shown, it is obvious that the remaining positions of the sequence switch may be similarly employed to control call announcements. In the case of a non-tandem call, the class sequence switch would advance sequence switch 420 directly to position 3 so that only the numerical designation could be transmitted. These latter circuits have been omitted for simplicity.

The opening of the fundamental circuit permits relay 505 to release as above mentioned, reconnecting the incoming trunk to relay 503, opening the circuit of relay 521 and removing the shunt from the winding of relay 509, which relay now operates. The release of relay 505 also opens the circuit of relay 520 and that relay releases after an interval due to its slow releasing character. With relay 505 released, the circuit of relay 521 is opened until relay 520 closes its back contact. The opening of this circuit permits relay 518 at the manual office to release and extend the circuit of relay 521 to the windings of relay 516 again. When the circuit of relay 521 is reclosed at the contact of relay 520, relay 521 cannot reoperate since the current is now in the wrong direction. When the operator at the local manual office has received the called line number she tests the line jack in the usual manner and assuming the line to be idle, inserts the plug 530 in the jack 531 of the called line. It will be noted that the sender automatically advances the district selector to talking position without waiting for the called subscriber to be signaled. Therefore, if the manual operator fails to understand the

number as announced by the sender, she may leave her listening key closed and obtain the correct wanted number from the calling subscriber. She then signals the wanted subscriber in the usual manner.

When the called subscriber answers a circuit is closed from battery, through the lower right winding of repeating coil 519, winding of supervisory relay 533, contact of the ringing key 534, ring of plug 530 and jack 531, over the subscriber's line 532, tip of jack 531 and plug 530, contact of ringing key 534, upper right winding of repeating coil 519 to ground. Relay 533 operates completing a circuit from ground, over its front contact, winding of relay 517, to battery. Relay 517 again reverses the direction of current to relay 521 which reoperates. The operation of relay 521 at its contact closes a circuit from battery, through the winding of relay 504, front contact of relay 509, back contact of relay 508, left back contact of relay 520 to ground at the front contact of relay 521. Relay 504 reverses the connection of relay 503 to the incoming trunk for supervisory purposes.

When the called subscriber restores his receiver, relay 533 releases in turn releasing relay 517 and restoring the connection of relay 516 to the circuit of relay 521. This changes the direction of the current through the winding of relay 521 causing that relay to release. Relay 521 in turn releases relay 504 and restores the direction of current over the incoming trunk preparing for release when the calling subscriber restores his receiver. The release by the calling subscriber releases relay 503 which may now be effective to display a disconnect signal (not shown) before the tandem operator. The tandem operator then withdraws plug 514 from plug 515 releasing relay 516 and extinguishing lamp 523 as a signal to the manual operator to remove plug 530 from jack 531. Relays 509 and 522 at the tandem office are released by means not shown when the connection is broken down.

What is claimed is:

1. In a telephone exchange system, a machine switching office, a tandem office, a manual office, means for registering a telephonic designation comprising an office designation and a numerical designation at said machine switching office, means for establishing a connection from said machine switching office to said tandem office, means responsive to the establishment of said connection to transmit said office designation to said tandem office, means to thereupon extend said connection to said manual office, and means responsive to said extension to transmit said numerical designation to said manual office.

2. In a telephone exchange system, a machine switching office, a tandem office, a

- manual office, means for registering a telephonic designation comprising an office designation and a numerical designation at said machine switching office, means under the control of said registered office designation for establishing a connection from said machine switching office to said tandem office, means responsive to the establishment of said connection to transmit said office designation to said tandem office, means to thereupon extend said connection to said manual office, and means responsive to said extension to transmit said numerical designation to said manual office.
3. In a telephone exchange system, a machine switching office, a tandem office, a manual office, means for registering a telephonic designation comprising an office designation and a numerical designation at said machine switching office, means under the control of said registered office designation for establishing a connection from said machine switching office to said tandem office, means responsive to the establishment of said connection to transmit said office designation to said tandem office, operator controlled means for extending said connection to said manual office, and means automatically responsive to said extension to transmit said numerical designation to said manual office.
4. In a telephone exchange system, a machine switching office, a tandem office, a manual office, means for registering a telephonic designation comprising an office designation and a numerical designation at said machine switching office, means for establishing a connection from said machine switching office to said tandem office, an operator's equipment at said tandem office, means to associate said operator's equipment with said connection, means responsive to such association to cause the transmission of said office designation to said tandem operator, means controlled by said operator to extend said connection to said manual office, operator's equipment at said manual office, means to associate said manual operator's equipment with said extended connection, and means responsive to said last association to cause the transmission of said numerical designation to said manual operator.
5. In a telephone exchange system, a machine switching office, a tandem office, a manual office, means for registering a telephonic designation comprising an office designation and a numerical designation at said machine switching office, means for establishing a circuit connecting said machine switching office and said tandem office, a polarized relay at said machine switching office in said connecting circuit, an operator's equipment at said tandem office, means to associate said operator's equipment with said circuit, means responsive to such association to reverse the direction of current flow over said circuit to operate said polarized relay and to thereby initiate the transmission of said office designation to said tandem operator, means for restoring the direction of current flow in said circuit following the transmission of said office designation, means controlled by the operator at said tandem office to establish a circuit between said tandem office and said manual office, a polarized relay at said tandem office in said latter circuit, operator's equipment at said manual office, means to associate said manual operator's equipment with said second circuit, means responsive to such association to reverse the current flow in said second circuit to operate the polarized relay at said tandem office, means responsive to the operation of said last mentioned polarized relay for again reversing the current flow in said first circuit to operate the polarized relay at said machine switching office, and means responsive to the reoperation of the polarized relay at said machine switching office to initiate the transmission of said numerical designation.
6. In a telephone exchange system, a machine switching office, a tandem office, a manual office, a sender at said machine switching office, means in said sender to register telephonic designations comprising registers for registering the office designation and registers for registering the numerical designation, means selectable by said registers for generating currents characteristic of the elements making up telephonic designations, means to establish a connection from said machine switching office to said tandem office, means to successively associate said registers with said connection, means responsive to the establishment of said connection to operate said associating means to transmit currents characteristic of said office designation to said tandem office, means for extending said connection to said manual office, and means responsive to said extension to reoperate said associating means to transmit currents characteristic of said numerical designation to said manual office.
7. In a telephone exchange system, a machine switching office, a tandem office, a manual office, a sender at said machine switching office, means in said sender to register telephonic designations comprising registers for registering the office designation and registers for registering the numerical designation, means selectable by said registers for generating currents characteristic of the elements making up telephonic designations, means to establish a connection from said machine switching office to said tandem office, a series of counting relays to successively associate said registers with said connection, means responsive to the establishment of said connection to operate

said relays to transmit currents characteristic of said office designation to said tandem office, means for extending said connection to said manual office, and means responsive to said extension to reoperate said relays to transmit currents characteristic of said numerical designation to said manual office.

8. In a telephone exchange system, a machine switching office, a tandem office, a manual office, a sender at said machine switching office, means in said sender to register telephonic designations comprising registers for registering the office designation and registers for registering the numerical designation, a call announcing mechanism having a plurality of sections for announcing the elements making up telephonic designations, said sections being selectable by said registers, means to establish a connection from said machine switching office to said tandem office, means to successively associate said registers with said connection, means responsive to the establishment of said connection to operate said associating means to announce said office designation to said tandem office, means for extending said connection to said manual office, and means responsive to said extension to reoperate said associating means to announce said numerical designation to said manual office.

9. In a telephone exchange system, a machine switching office, a tandem office, a manual office, a sender at said machine switching office, means in said sender to register telephonic designations comprising registers for registering the office designation and registers for registering the numerical designation in said sender, a call announcing mechanism having a plurality of sections for announcing the elements making up telephonic designations, said sections being selectable by said registers, means to establish a connection from said machine switching office to said tandem office, a series of counting relays to successively associate said registers with said connection, means responsive to the establishment of said connection to operate said relays to announce said office designation to said tandem office, means for extending said connection to said manual office, and means responsive to said extension to reoperate said relays to announce said numerical designation to said manual office.

10. In a telephone exchange system, a machine switching office, a tandem office, a manual office, a calling subscriber at said machine switching office, a called subscriber at said manual office, a sender at said machine switching office, means in said sender to register telephonic designations comprising registers for registering the office designation and registers for registering the numerical designation, a call announcing

mechanism having a plurality of sections for announcing the elements making up telephonic designations, said sections being selectable by said register, means to establish a connection from said machine switching office to said tandem office, a series of counting relays to successively associate said registers with said connection, means responsive to the establishment of said connection to operate said relays to announce said office designation to said tandem office, means for extending said connection to said manual office, means responsive to said extension to reoperate said relays to announce said numerical designation to said manual office, and means responsive to the completion of the reoperation of said counting relays to establish a talking connection between said calling subscriber and said called subscriber.

11. In a telephone exchange system, a plurality of offices, a plurality of registers at one of said offices for registering an office designation and a plurality of registers for registering a numerical designation, means selectable by said registers for generating currents characteristic of the elements making up said designations, means to establish a connection between said one office and another office, a series of relays, means to operate said relays to successively associate said office registers with said connection, and means to thereupon reoperate said relays to associate said numerical registers with said connection.

12. In a telephone exchange system, a plurality of offices, a plurality of registers at one of said offices for registering an office designation and a plurality of registers for registering a numerical designation, means selectable by said registers for generating currents characteristic of the elements making up said designations, means to establish a connection between said one office and another office, a series of relays, means to operate said relays to successively associate said office registers with said connection, means to extend said connection to a third office, and means to thereupon reoperate said relays to associate said numerical registers with said connection.

13. In a telephone system, a telephone circuit, means for reversing the direction of current flow over said circuit comprising a pair of relays, means controlled by the first of said relays to extend said circuit to a current source in one direction through the windings of the second of said relays, means controlled by said second relay for operating said first relay, and means thereupon controlled by said first relay for extending said circuit to said current source in the opposite direction through windings of said first relay.

14. In a telephone system, a telephone

- circuit, means for reversing the direction of current flow over said circuit comprising a pair of relays, means controlled by the first of said relays to extend said circuit to a current source in one direction through the windings of the second of said relays, means controlled by said second relay for operating said first relay through one of its windings, and means thereupon controlled by said first relay for extending said circuit to said current source in the opposite direction through other windings of said first relay.
15. In a telephone system, a telephone circuit, a polarized relay in said circuit, means for reversing the direction of current flow over said circuit to operate said polarized relay comprising a pair of relays, means controlled by the first of said relays to extend said circuit to a current source in one direction through the windings of the second of said relays, means controlled by said second relay for operating said first relay, means thereupon controlled by said first relay for extending said circuit to said current source in the opposite direction through windings of said first relay.
16. In a telephone system, a telephone circuit, a polarized relay in said circuit, means for reversing the direction of current flow over said circuit to operate said polarized relay comprising a pair of relays, means controlled by the first of said relays to extend said circuit to a current source in one direction through the windings of the second of said relays, means controlled by said second relay for operating said first relay, means thereupon controlled by said first relay for extending said circuit to said current source in the opposite direction through windings of said first relay, and means responsive to the operation of said polarized relay to transmit a telephonic designation over said circuit, and means effective following the transmission of said designation to release said first relay to again extend said circuit to said current source through the windings of said second relay.
17. In a telephone system, a telephone circuit, a polarized relay in said circuit, means for reversing the direction of current flow over said circuit to operate said polarized relay comprising a pair of relays, means controlled by the first of said relays to extend said circuit to a current source in one direction through the windings of the second of said relays, means controlled by said second relay for operating said first relay, means thereupon controlled by said first relay for extending said circuit to said current source in the opposite direction through windings of said first relay, means responsive to the operation of said polarized relay to transmit a telephonic designation over said circuit, and means effective following the transmission of said designation to release said first relay to again extend said circuit to said current source through the windings of said second relay.
- In witness whereof, I hereunto subscribe my name this 3rd day of October, A. D. 1927.

HARRY C. CAVERLY.