

March 6, 1945.

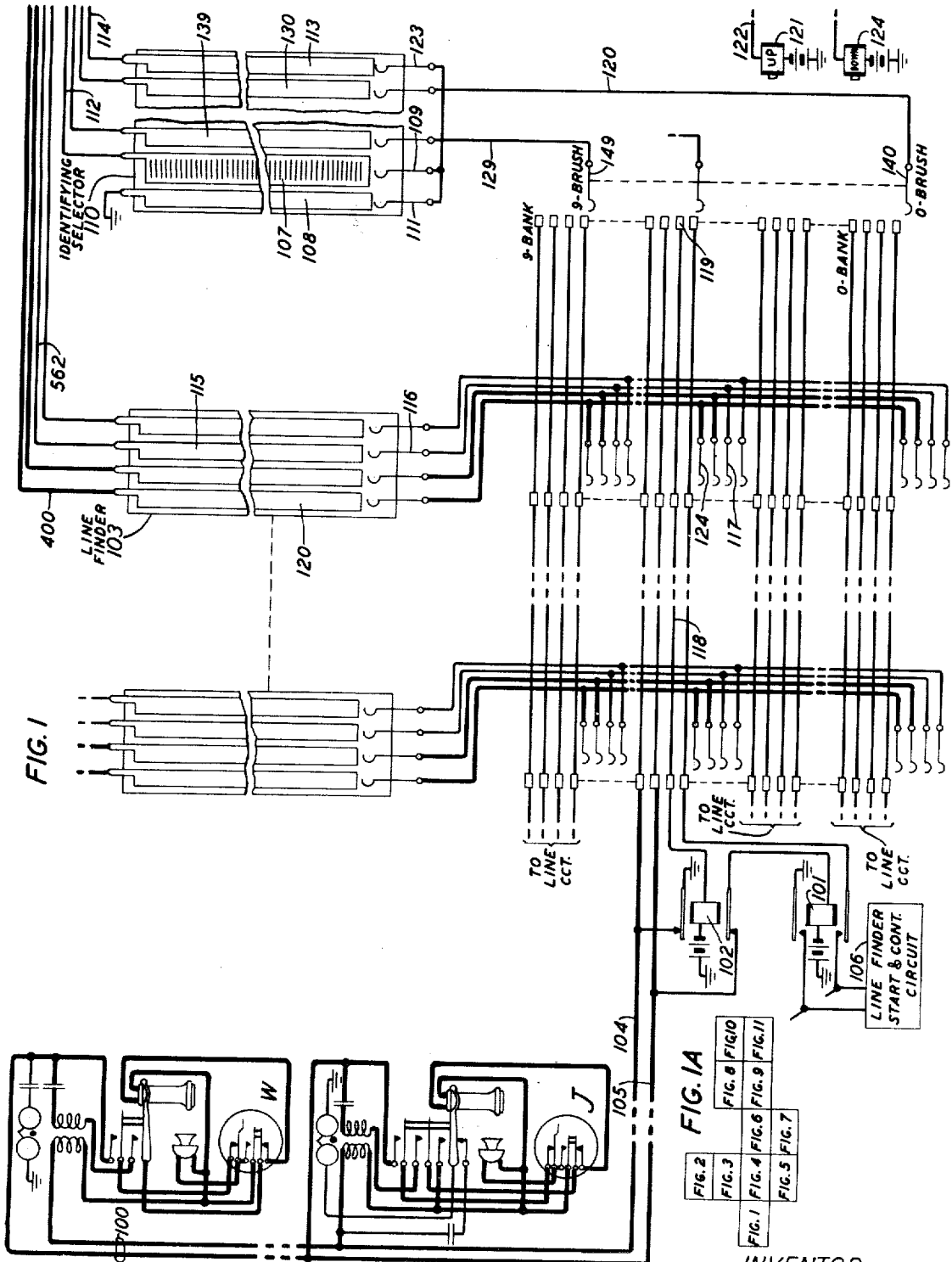
L. E. KITTREDGE

2,370,736

TELEPHONE SYSTEM

Filed March 13, 1940

11 Sheets-Sheet 1



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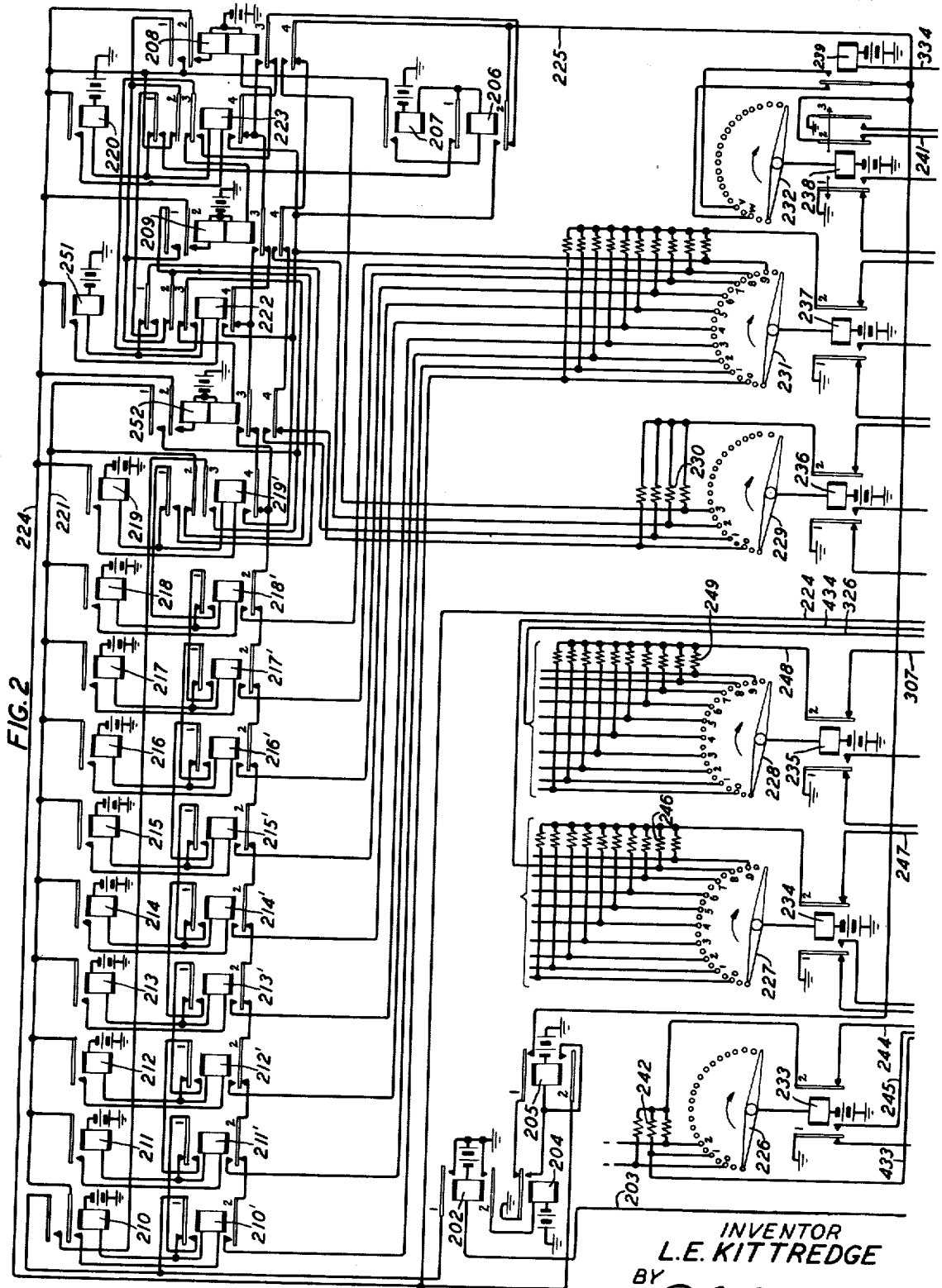
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11 Sheets-Sheet 2



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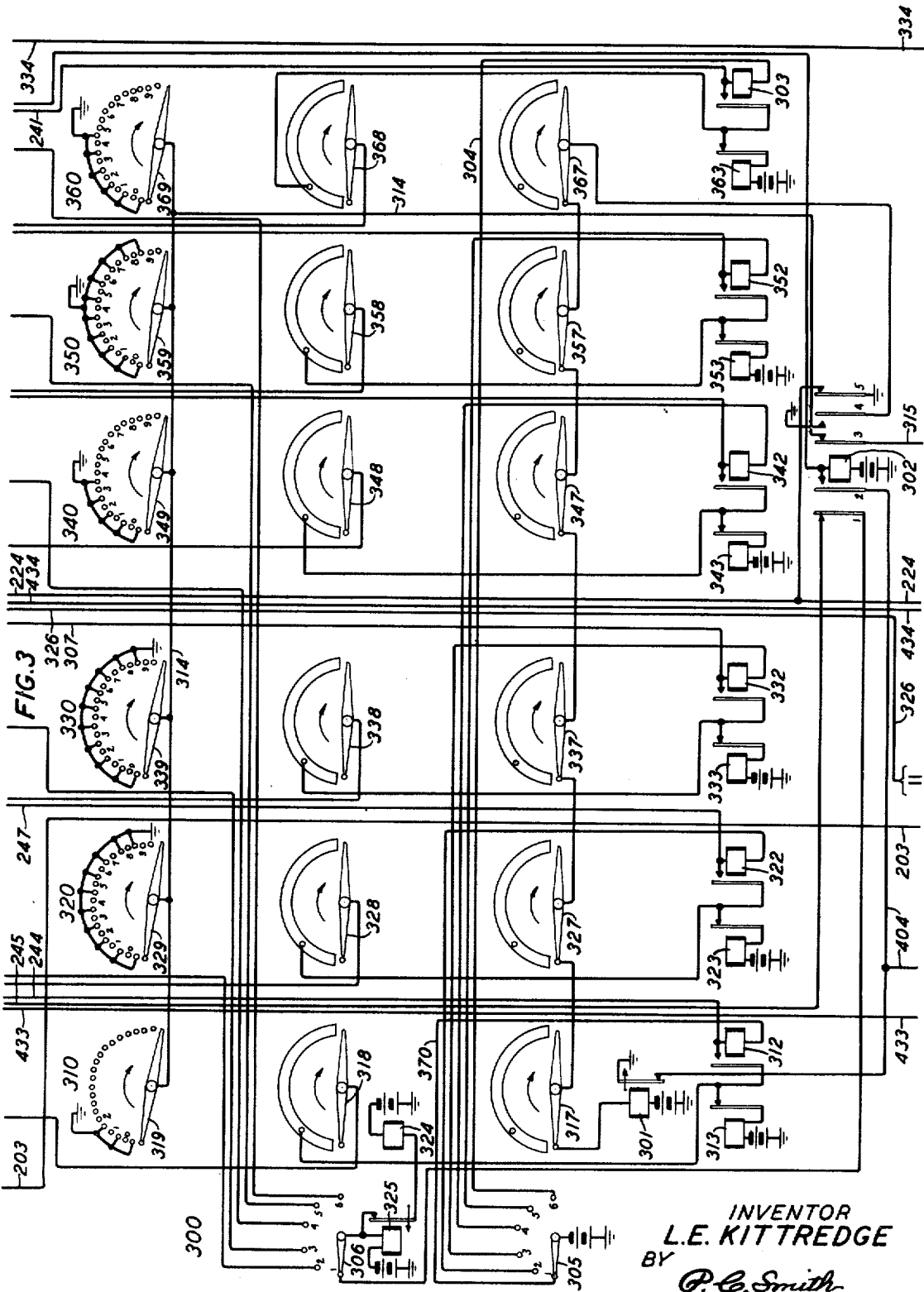
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11 Sheets-Sheet 3



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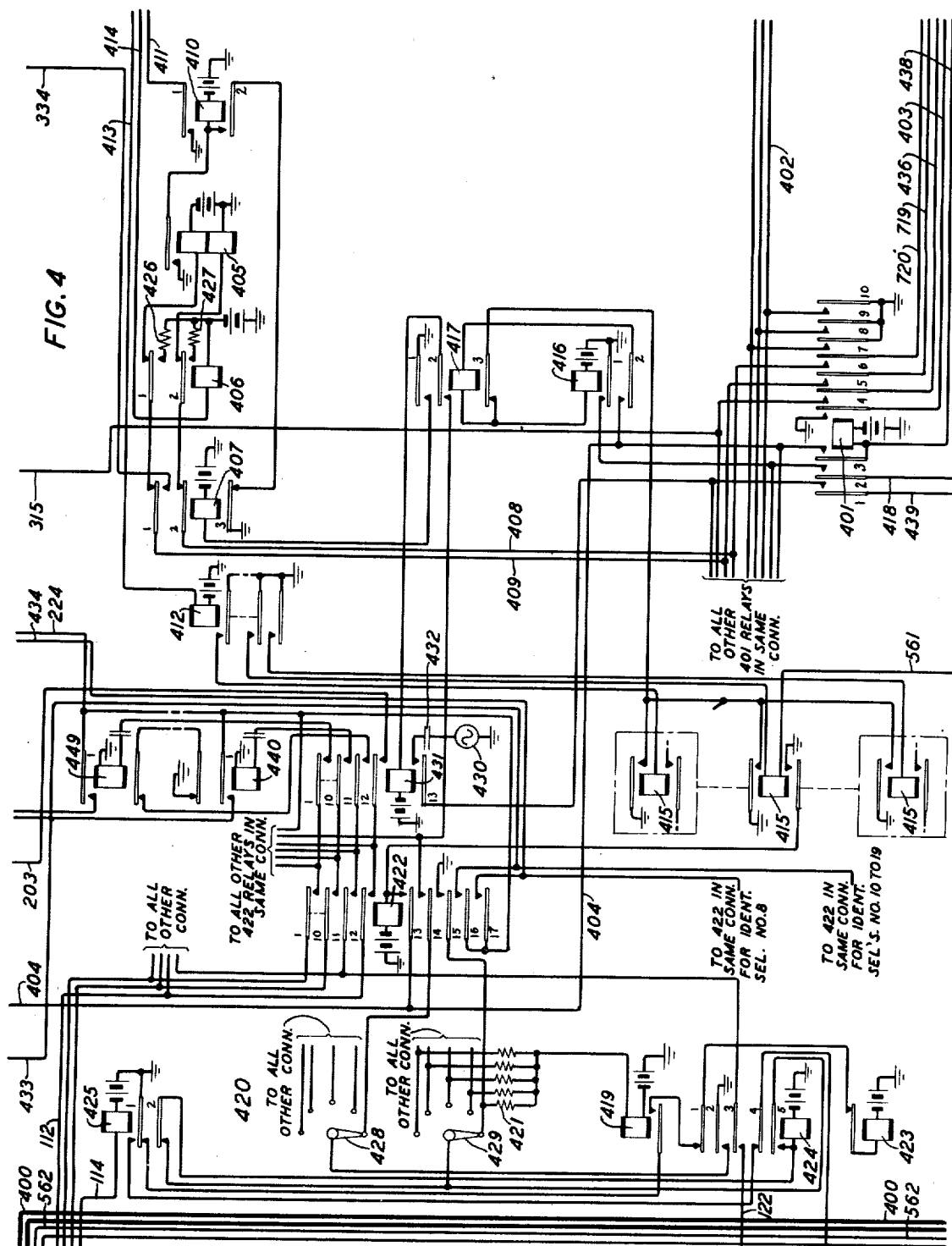
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11 Sheets-Sheet 4



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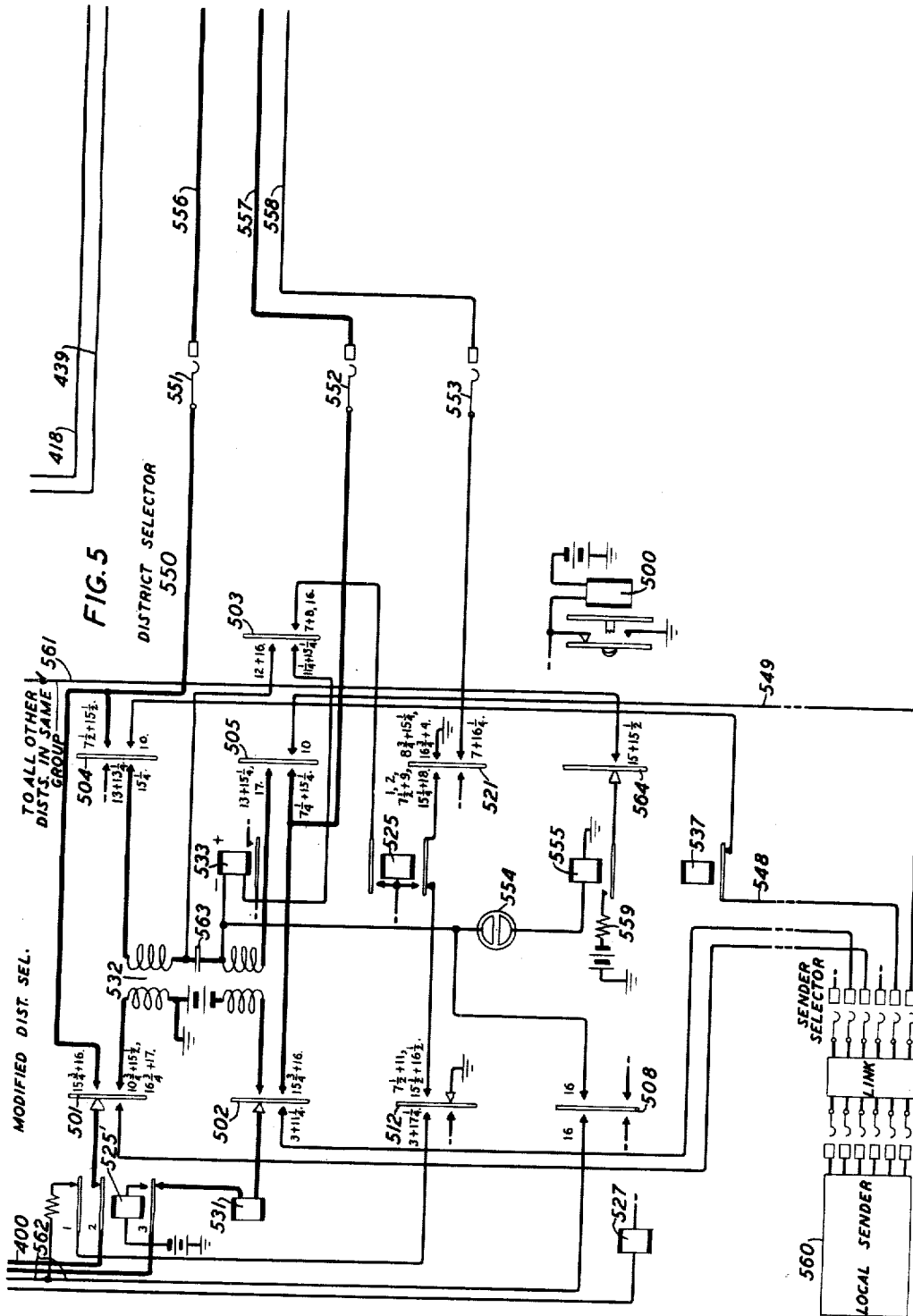
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11 Sheets-Sheet 5



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TELEPHONE SYSTEM

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11 Sheets-Sheet 6

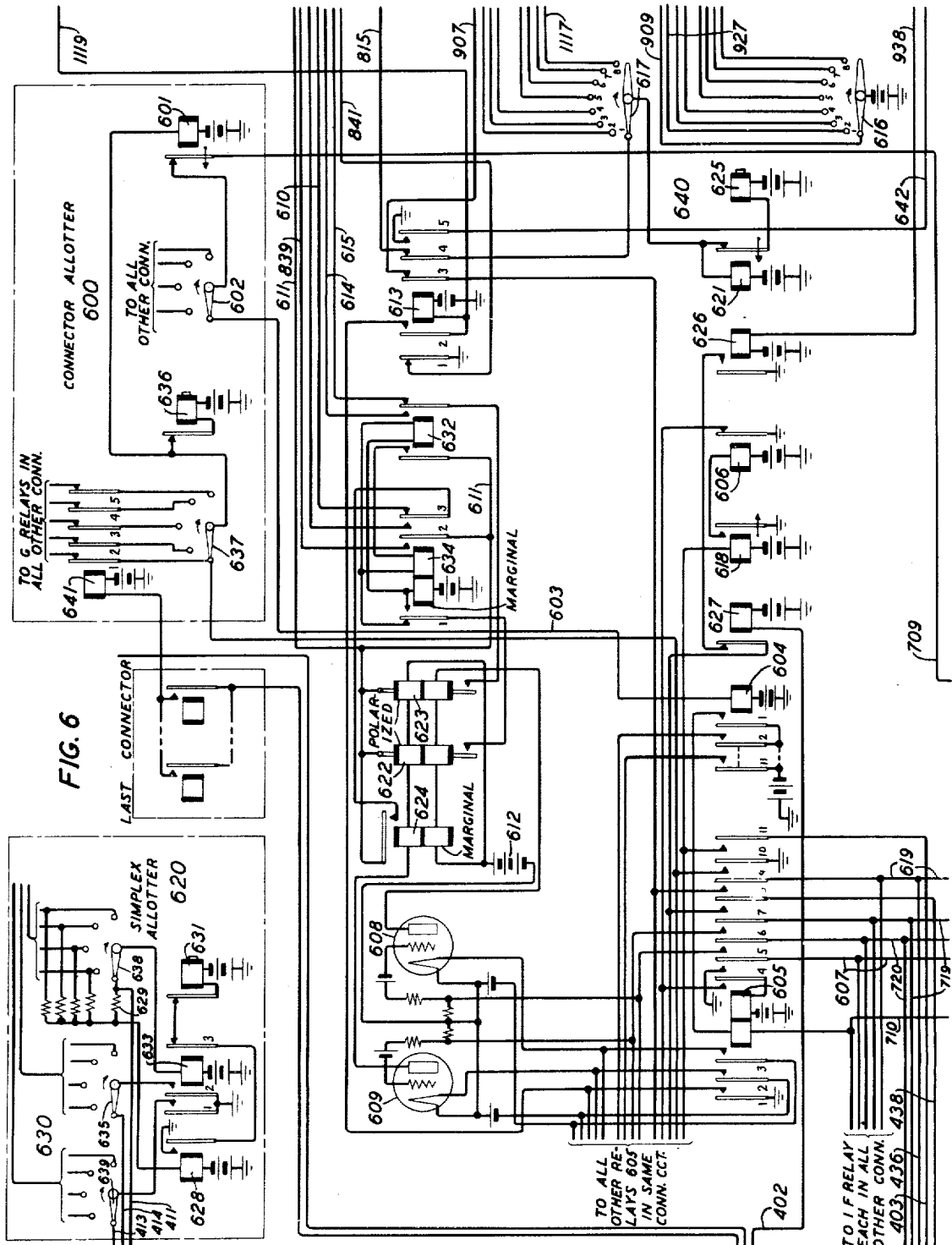


FIG. 6

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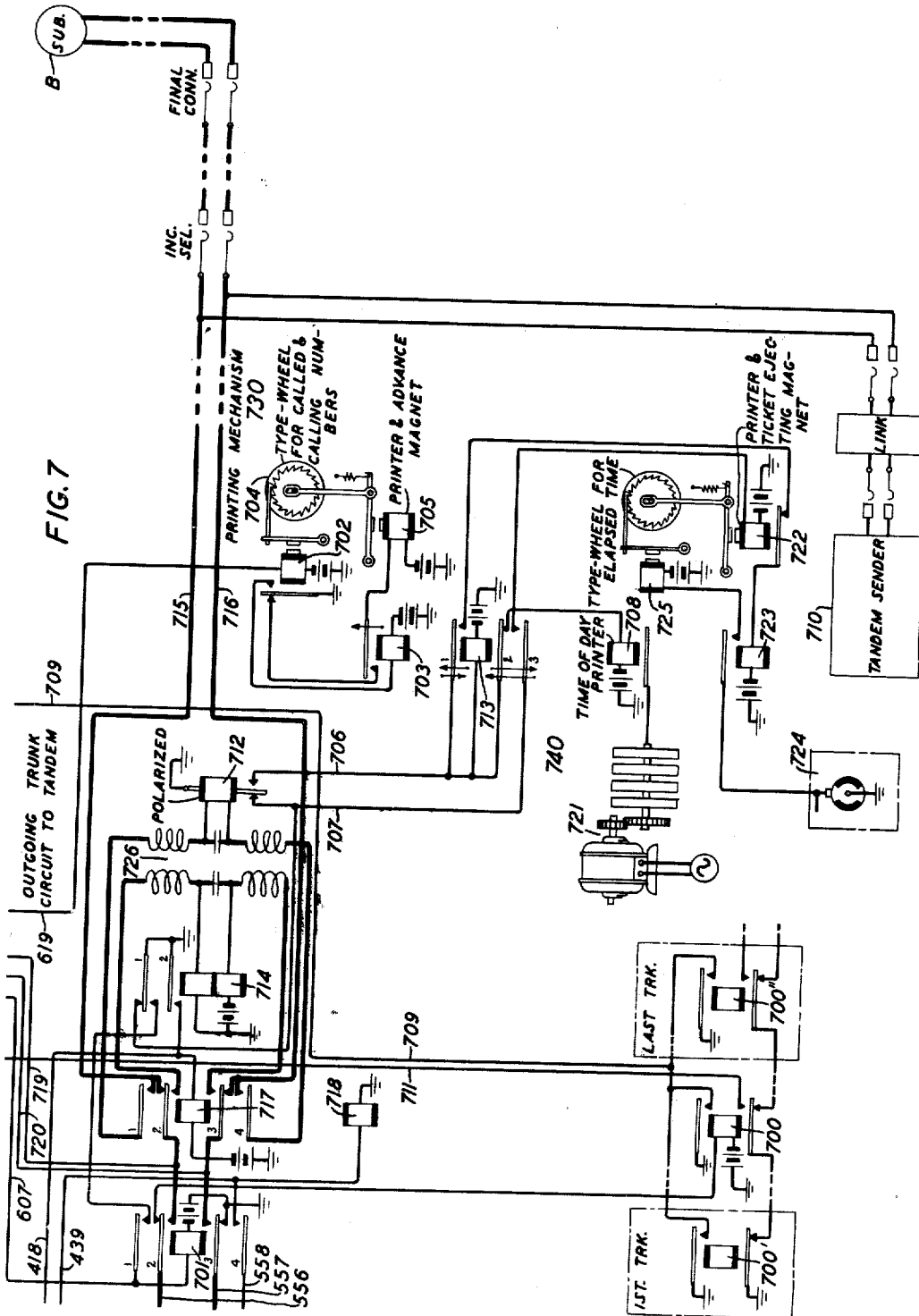
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11 Sheets-Sheet 7



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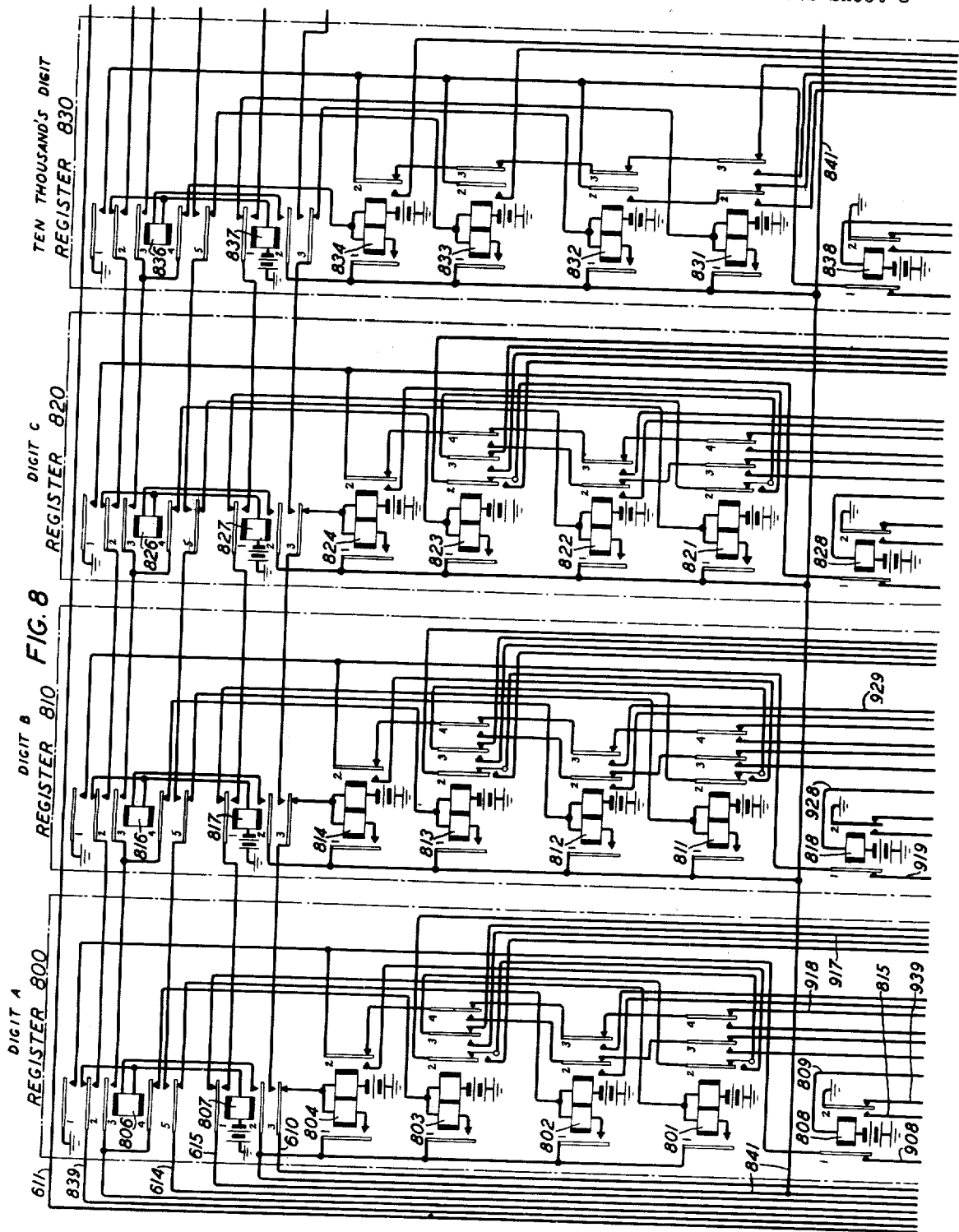
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11 Sheets-Sheet 8



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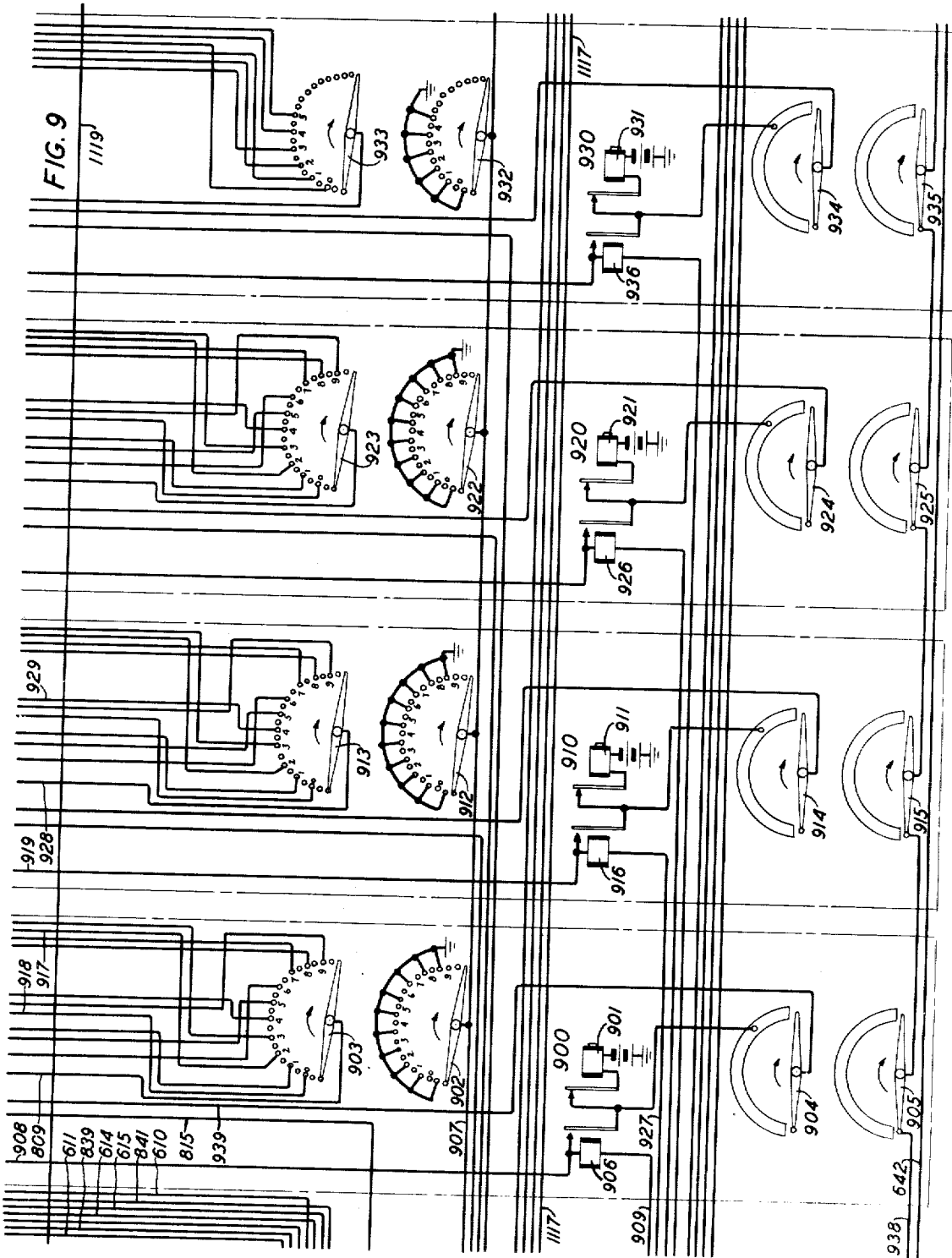
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11 Sheets-Sheet 9



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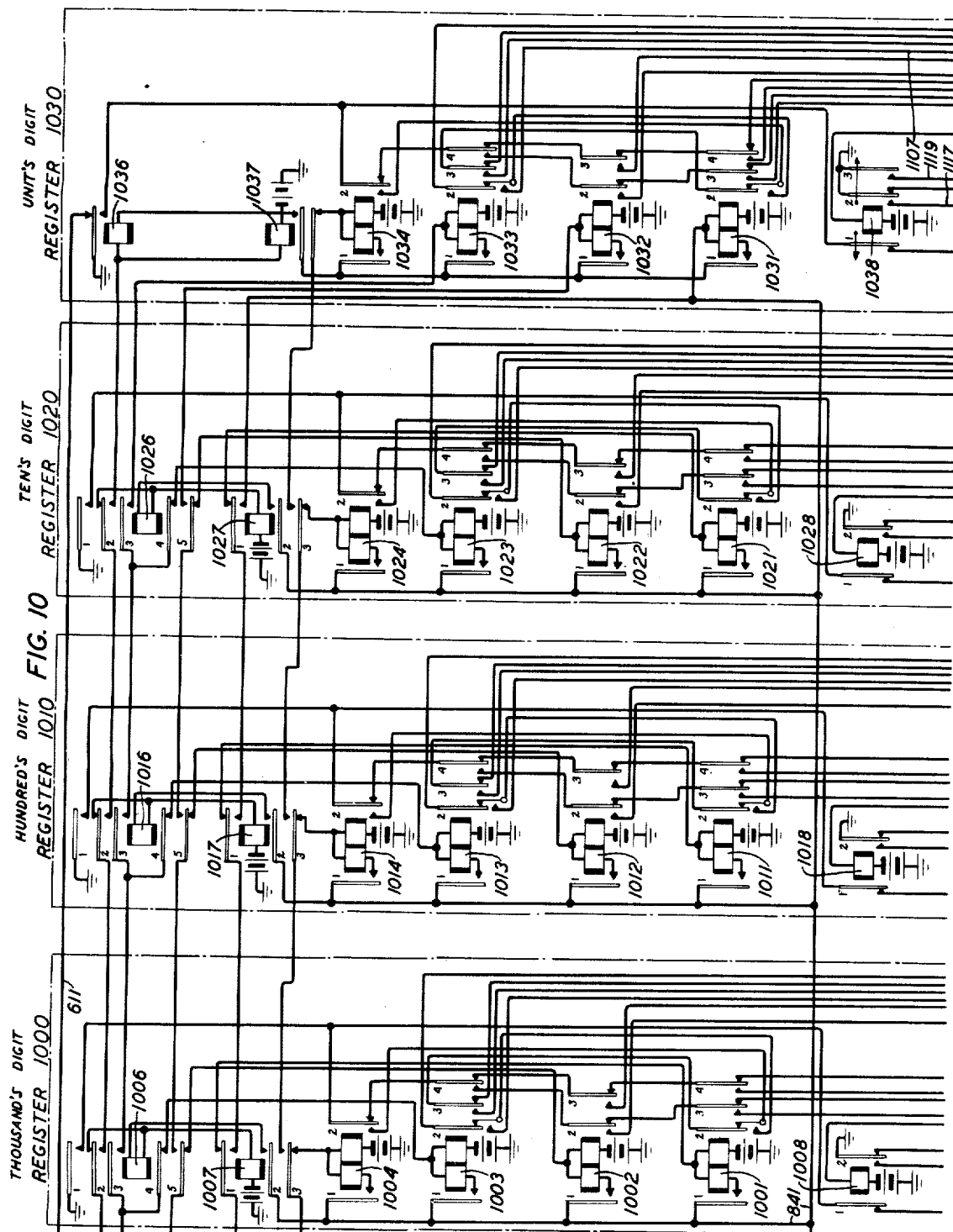
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TELEPHONE SYSTEM

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11 Sheets-Sheet 11

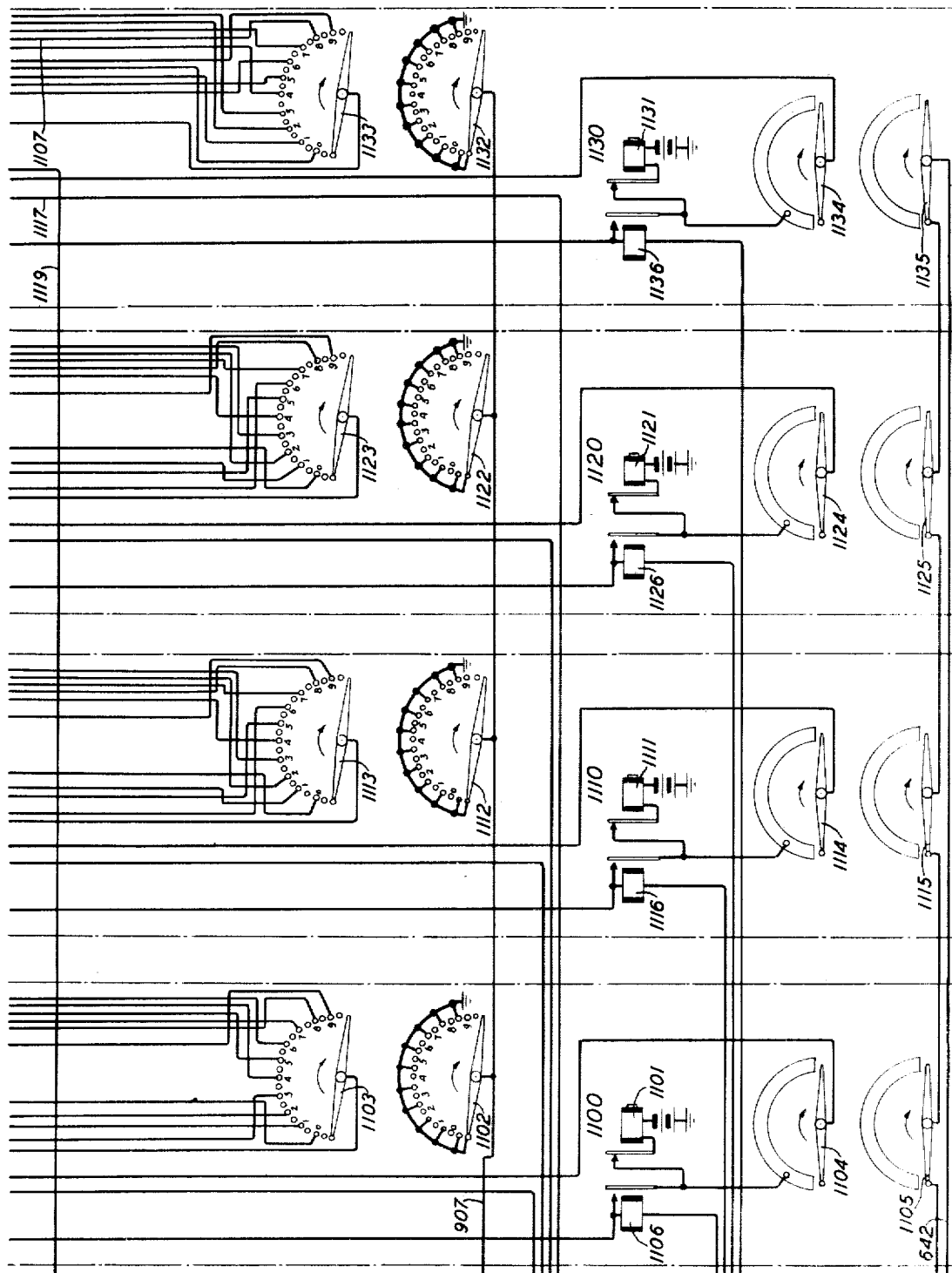


FIG. 11

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UNITED STATES PATENT OFFICE

2,370,736

TELEPHONE SYSTEM

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Application March 13, 1940, Serial No. 323,666

10 Claims. (Cl. 179-7.1)

This invention relates to telephone systems and more particularly to automatic recording equipment for such systems that embodies means for making a permanent record of the calling line number, the called line number, and the duration of a connection automatically established between two lines.

At the present time it is well known that charges for local telephone service are usually recorded upon message register meters associated with the calling lines regardless of whether the telephone system of which these lines form a part is a manual, semiautomatic or full automatic system, and that said meters are operated when the called subscribers remove their respective receivers from their switchhooks as evidence of completed connections.

Recent advances in the automatic telephone art, however, make it desirable to have subscribers dial directly the office and number of wanted subscribers who are located outside the local area. As is well known, toll calls are timed and ticketed by an operator, one of whose duties is to make out a ticket for each call. Upon this ticket are recorded the calling and called line numbers and the duration of the connection so that, when the monthly bill for the subscriber is made, the entries on these tickets are included as separate items thereon. Timing and ticketing, however, involve considerable delays at the position through which the line of a calling subscriber, seeking a toll connection, must be routed before completion thereto by manual or semiautomatic means, and such delays have a tendency to cancel a portion of the efficiency of operation gained by establishing connections with switching mechanisms controllable from a sending device at the calling station.

My invention is intended to overcome this obstacle of manual recording of the data of a toll connection by providing facilities at the central office that will automatically record the calling and called line numbers of the two lines involved in a toll connection together with a record of the duration of the conversation, thus eliminating the necessity of a manual recording position at the toll switching center and thus making possible the logical extension of the principle of mechanical switching to distant toll areas. The present invention, therefore, in its adaptation and application to a telephone plant, has for its broad object a system of apparatus and operating circuits whereby the details of a toll connection such as, for example, the number of the calling line, the

number of the called line and the duration of the conversation are automatically recorded by a device associated with one of the trunks of the connection,

One of the features of the invention is an identifying selector which is used to locate the terminals of the calling line subsequent to the initiation of a call, a settable register which, cooperating with said selector, is operated to register the movement of the selector in terms of the terminals travelled over to reach the terminals of the calling line, and a series of pulsing switches operatively responsive to the setting of said register to transmit to the recording device a group or groups of pulses indicative of the calling line terminal number as evidenced by the number of steps taken by said selector and registered in said settable register.

Another feature of my invention is to be found in the use of a second settable register which is adapted to respond to the transmission of the called pulse dial code from the local register sender into which it is registered following the dialing of the same therein from the impulse device at the calling line, in combination with another series of pulsing switches operatively responsive to the setting of said register to transmit to the recording device a plurality of groups of pulses indicative of the called line designation.

Yet another feature of my invention is a connector circuit common to a group of trunks and switching selectors over which toll connections are established, in which may be incorporated the two settable registers and pulsing switches mentioned above, thus affording considerable economy of equipment in that said registers may be utilized in common by a plurality of trunks and switching selectors.

Yet another feature of the invention is to be found in the operation of one recording device by the connector in causing the production of a permanent record of the calling line designation over one connection with which said connector is operatively associated, and simultaneously therewith in causing the operation of another recording device by said connector in causing the production of a permanent record of the called line designation over another connection with which said other recording device is associated. By virtue of this "double connection" to two separate calling lines in different stages of call establishment, connector holding time is reduced to a minimum and, therefore, less connector circuits for a given group of switching selectors and outgoing trunks will be necessary than otherwise would be the case

if a connector were utilized for one connection at a time.

One embodiment of the invention which is herein described by way of illustration is adapted for operation with mechanical switches of the well-known panel type which are used to extend subscribers' lines over tandem routes and the invention comprises, broadly, an identifying selector for a given group of line-finder switches, a connector circuit available to a plurality of groups of line-finder switches and outgoing trunks connectable therewith, and including two settable registers and pulsing switches for translating the setting of said registers into suitable groups of impulses indicative of the separate settings, and recording means in each of the outgoing trunks accessible to the line-finder switches which are responsive to the impulses transmitted thereto from the pulsing equipment of a connector and also responsive to timing equipment in the trunks themselves for measuring the duration of the connection thereover.

Before proceeding with an outline of the invention it is advisable to point out the general operation of so-called tandem connections, which are telephone connections established between two subscribers located in different telephone offices that are joined by trunk lines extending to and radiating from a tandem office. Thus when a subscriber in a local office dials a number in another office which is reached through the tandem center, a line-finder switch becomes connected to the line in the usual way and a free local register sender becomes connected thereto to receive the dial impulses of the called number. The register sender, in response to that portion of the called number which designates the called office, directly controls the operation of a district selector in selecting a trunk line which terminates as a selector in the tandem office and having access to groups of trunk lines leading to various offices radiating from tandem. Upon the seizure of this tandem selector, a tandem register sender becomes connected thereto and thereafter receives from the local sender over the selected tandem selector a series of impulses which designate both the wanted office and the wanted number therein. The tandem register sender thereupon guides the tandem selector to select a trunk line that connects with the wanted office (in accordance with the code of the office registered in the tandem sender) and, at the distant office when this trunk line is selected, further guides the local selectors into respective positions to reach the wanted line, whereupon the called subscriber is rung in the usual way and conversation ensues. Upon answer of the called party a signal is relayed back causing the operation of the line message register once. If the conversation lasts longer than a prescribed period, then timing devices in the district selector record the additional charge intervals and operate the line message register as many times as required by the number of over-time intervals which have elapsed.

It will be noted that the operations above described, which are typical of tandem connections established over panel equipment facilities, are all automatic, that is, the intermediate service of an operator is not required at the tandem office either to record the details of the call for billing purposes or to otherwise complete the connections on a manual basis from that point.

In establishing calls on a tandem basis for suburban points, however, straightforward auto-

matic operation controlled by the subscriber's dial are uneconomical in that the charges for the call are different from and usually higher than those which are strictly local in character and, also, for the reason that, because of the higher charges, the subscriber is served with an itemized account of his suburban calls at the time he is billed. In order, therefore, to provide completely automatic service in such cases, it becomes necessary to do automatically what the recording operator does manually; that is, provide automatic recording equipment which is adapted to record, in permanent form, all items of information relating to the connection.

In general, the method of operating my invention is as follows: When the invention is adapted for application to an automatic telephone system of the panel type disclosed in Patent 1,862,549 issued to R. Raymond and W. J. Scully on June 14, 1932, and in Patent 1,840,132 issued to T. H. Roberts on January 5, 1932, the former patent disclosing the circuits and equipment of a local central office having access to trunks leading to a tandem center and the latter patent disclosing the circuits and equipment at the tandem center which are operatively responsive to the extension of a local connection thereto, the subscriber dials a suburban number, the effect of which is to cause the local sender to direct the district selector to an outgoing or tandem trunk which leads to the tandem switching office. Upon the seizure of said tandem trunk an idle connector circuit is attached thereto. This connector circuit includes registers and pulsing equipment used in common by a number of tandem trunks and associated district selectors, and when it becomes attached to a tandem trunk the local sender transmits thereover to a tandem sender attached to the trunk a plurality of groups of pulses indicative of the wanted line, which pulses are registered in the tandem sender and used for selectively positioning the tandem trunk and a train of other selectors to reach the wanted line. In the connector circuit, electronic devices are provided by means of which the pulses, as they are being transmitted over the trunk, are picked up and registered in a register provided for the purpose, after which they are transmitted into the recording equipment of the tandem trunk where a permanent record is made of them to indicate the numerical designation of the called line.

Each group of lines terminates on a particular line-finder frame to which a group of line-finder switches has access, said switches being paired with district selectors that have access to tandem trunks, and this line-finder frame is further provided with a special line-finder switch, herein termed an "identifying selector." When the called number designation is disposed of by causing a permanent record of it to be made by the recording device of the tandem trunk, the connector proceeds to identify the calling line-finder frame and to obtain access to the identifying selector of that frame, to its terminal-engaging brushes and to the up and down drive magnets of said selector.

In the connector, a test relay is connected to each brush of the selector, the selector elevator will be started upward in quest of the calling line while the connector applies a tone potential on the sleeve conductor of the line via the extension thereof in the district selector. The identifying selector, in moving upward, tests all the terminal banks simultaneously and causes the number of

terminals passed over, before reaching the terminals of the calling line, to be counted and registered in the connector. When the terminal marked by the tone is reached, one of the test relays in the connector will operate to indicate the particular bank of terminals in which the terminal of the calling line appears, the elevator will be stopped while engaged on the terminals to which it was connected when the relay operated, and counting operations will cease when the terminal is reached to which the calling line is connected.

As in the case with making a permanent record of the called line number from the setting of registers in the connector responsive to the transmission of the called pulse code from the local sender to the tandem sender, so too, a permanent record is made of the calling line number from the operation of one of the test relays and the extent of the counting operations in response to the movement of the identifying selector, by causing the operation of pulsing equipment in response to the operated test relay and in response to the equipment that registered the counting, the former being productive of a number of pulses which indicate the number of the brush used in connecting the identifying selector with the terminal of the calling line and the latter being productive of a number of pulses which indicate the particular terminal, from the bottom of the bank of terminals to which the selected brush has access, to which the tone potential was applied. When the number of terminals in a bank are subdivided into a plurality of groups, which is the most common practice in panel line-finder systems, the counting circuit may be arranged (as it is arranged in the present embodiment of the invention) to register the group of the calling line as a separate item, and then the terminal in the group to which said line is connected. The pulses thus produced are transmitted to the recording equipment associated with the tandem trunk and permanently recorded thereby as the designation of the called line terminal.

The recording device associated with each tandem trunk is provided with timing equipment that operates in response to the usual reverse battery signal given over the trunk when the called subscriber answers. Time-spaced impulses are transmitted by this equipment to the recording device as long as the connection is maintained by both subscribers and recorded thereby as a measurement of the duration of the conversation. When either subscriber restores, the timed impulses are stopped.

A clearer conception of the scope and purpose of the invention can be obtained from the following detailed description and appended claims taken in connection with the attached drawings in which:

Fig. 1 shows a two-party line circuit, the group of line-finder selectors accessible thereto, and the identifying selector;

Figs. 2, 3 and 4 show the calling lines register of the connector circuit;

Fig. 5 shows the district selector paired with one of the line-finder switches shown in Fig. 1;

Fig. 7 shows the tandem trunk and the recording equipment associated therewith;

Figs. 6 and 8 to 11, inclusive, show the called line register circuit of the connector; and

Fig. 1A shows the manner in which all of the above-mentioned figures should be arranged with respect to each other to disclose the invention completely.

When a long distance call is initiated at either station, say station J or station W of line 100, by the removal of the receiver from the switchhook, the line relay 101 is operated over a circuit which extends from battery through the winding of said relay, lower contacts of cut-off relay 102, line conductor 105, over the station loop, back to line conductor 104 to ground on the upper contacts of relay 102. Relay 101 operates and closes a current path for a start relay in the line-finder start and control circuit 106 which is fully disclosed in the above-mentioned Raymond-Scully patent. In consequence of the operations in said line-finder start and control circuit, an idle line-finder switch such as, for example, line-finder switch 103, is caused to operate and hunt for the terminals of the calling line, all in a manner well known to the art and as described in the above-mentioned patent. When the line-finder switch engages the terminals of the calling line, which may be assumed to terminate in the terminals of a bank intermediate the 0 bank and the 9th bank, the sequence switch 500 of the district selector 550 is, according to the above-mentioned patent, advanced to position 3 whereupon a link is operated to connect the terminals of the district selector to the terminals of an idle local sender. The link and sender, like the line-finder start and control circuit, are likewise disclosed and described in the above-mentioned patent and since they form no part of the present invention except in so far as they cooperate with the circuits of the present invention to cause the selective positioning of a train of selectors to reach the terminals of the wanted line, said link and sender are neither shown nor described herein except by the numeral 560, which designates the sender in conventional block form, the link being disclosed, also conventionally, as a movable connecting medium intermediate the terminals of the district selector and those of the sender. Reference, however, is made to the above-mentioned Raymond-Scully patent for all circuit operations mentioned herein as taking place in the sender and described in said patent.

Upon the connection of the sender 560 to the district selector, dial tone is transmitted in the well-known manner to the subscriber's station from the sender via the district selector and line finder, whereupon the subscriber proceeds to dial the desired number which, in this case and since the call is to be, say, a suburban connection that will be completed through a mechanical tandem office, will comprise one series of digits that designates the wanted office and another series of digits that designates the number of the wanted subscriber in that office. When the registration in the sender has proceeded to the point where the district selector 550 may be selectively positioned upon the terminals of an outgoing trunk that terminates at the tandem office, said sender closes the well-known fundamental circuit between it and relay 525 of the district selector by means of which reverive pulses are transmitted to the sender as brushes 551, 552 and 553 of said selector move into engagement with the terminals of a free outgoing trunk. In this connection, it may be remarked that only such portions of the district selector circuit 550 are disclosed in Fig. 5 as are necessary to a complete understanding of the invention, this district being identical to the district disclosed in Figs. 1 and 2 of the Raymond-Scully patent above mentioned except for the addition of discharge device 554 and relay 555. For convenience in referring back to said patent for

a study of such parts of the operation of the district selector as are not covered by the present specification and shown in Fig. 5, the last two numerals of the designation of each equipment element and conductor in said figure have been made to correspond with the last two numerals of the designations of corresponding equipment elements and conductors in Figs. 1 and 2 of said patent. Reference, therefore, is made to such patent for a complete description of the operation of district selector 550 as well as the sender, link and line-finder start and control circuit as above mentioned.

During all of the above-mentioned pulsing operations the district selector sequence switch 500 is successively advanced from position 3 to position 10, as described in the above-mentioned Raymond-Scully patent, at which time, with brushes 551, 552 and 553 positioned upon the terminals of the outgoing trunk to tandem, a circuit is completed for relay 700 in said trunk which extends from battery through the winding of said relay, No. 2 contacts of relay 701, conductor 556, brush 551, right springs of cam 504, contacts of relay 537, conductor 548, a metallic path in the sender through a contact controlled by the fundamental circuit, conductor 549, lower springs of cam 505, brush 552, conductor 557, No. 3 contacts of relay 701, to ground.

Relay 700 is individual to the particular tandem trunk herein being used to illustrate the progress of the call. Other relays shown in Fig. 7 and labeled 700'—700'' etc. are corresponding relays in other outgoing trunks of the same group. These relays are so arranged that, although more than one may be operated in response to associated trunks to tandem being seized by calling district selectors, yet only one of them will be effective at a time to seize the connector allotter circuit 600 shown in Fig. 6, as explained hereinafter. Thus when relay 700 operates, it completes a circuit from ground over its upper contacts, conductor 709, contacts of slow release relay 601 of the connector allotter 600, brush 602, conductor 603, winding of relay 604 to battery. Relay 604 is a multicontact relay whose armatures are all connected to battery and each of whose make contacts connects to the winding of a relay such as relay 605, for example, which, in each connector circuit, is individual to each trunk in the group of trunks extending to the tandem office. Hence when relay 700 operates, battery is connected to each relay 605 in the connector. However, if there is more than one relay 700 operated which, as said before, will be the case if more than one tandem trunk is seized at the same time by as many hunting district selectors, only that relay 605 in the connector will operate which is individual to the trunk whose relay 700 is in a certain preferential order with respect to the other relays 700'—700''. The reason for this is because the operating circuit of said relay 605 is closed over a series path which extends from ground on the bottom back contacts of relay 700' of the first trunk in the group, serially through the back contacts of all the relays of the other trunks in the group, the bottom front contact of the first operated relay 700 which cuts off the chain path to succeeding relays 700, conductor 711, left winding of relay 605 to battery on the appropriate pair of contacts of relay 604. Obviously if two or more relays 700 happen to be operated at the same time, it is clear that only one relay 605 in the connector circuit will be operated notwithstanding the operation of more than one relay 700. While all the

relays 700 that will be operated can cause the operation of relay 604 that connects battery to each of the relays 605 in the connector which, like each of the relays 700 in the group 700'—700'' are each associated with separate trunks in the group, yet only the circuit of the relay 605 which is associated with the first operated relay in the group of relays 700'—700'' will be closed since the circuit of all other relays 605 will be opened by the back contacts of the succeeding operated relays in the group of relays 700'—700''.

Relay 605, in operating, closes its No. 4 contacts and locks to ground thereover on the contacts of relay 606 which is normal at this time; over its Nos. 2 and 3 contacts it closes the filament circuit of electronic devices 608 and 609 whose operations will be described shortly; over its No. 1 contacts it completes a partial locking circuit for relay 613; over its Nos. 6 and 7 contacts it connects the grids of electronic devices 608 and 609 to conductors 557 and 556, respectively, via the Nos. 3 and 2 contacts, respectively, of relay 701 and thence into the sender via (on the one side) brush 551, right springs of cam 504, contacts of relay 537 to conductor 548 and (on the other side) brush 552, lower springs of cam 505 to conductor 549; over its No. 8 contacts it completes a partial path for relay 401 via conductor 438; over its No. 9 contact it closes one point in the path of the winding of the type wheel magnet 702 whose function and operation will be described in the appropriate order; over its No. 10 contacts it completes a circuit to magnet 626 via the brush 637 and the interrupter contacts of said magnet, and in parallel with said magnet at the brush 637, with the winding of relay 601 causing both said magnet and said relay to operate and step the brushes 602 and 637 of allotter switch 600 to the terminals of a free connector; over its No. 11 contacts it closes a point in the circuit of relay 618 which relay, however, does not operate until relay 401 operates, which occurs at the time when the connector is ready to record the calling line number, as more particularly described hereinafter; while over its No. 5 contacts it completes a circuit for relay 701 which extends from ground on said contacts, conductor 607, winding of relay 701 to battery. The circuits completed above further extend the operation of the system in the manner noted below.

Relay 701 operates and opens the circuit of relay 700 which releases, in turn releasing relay 604 which disconnects battery from the operating windings of all relays 605 without, however, affecting the release of the one relay 605 which has been operated since said relay is locked to the contacts of relay 606 as above described; grounds the sleeve terminal through the conductor 558 via the No. 4 contacts and the winding of coil 718, extends the talking conductors connected to brushes 556 and 557 over its Nos. 2 and 3 front contacts, respectively, to the No. 2 and No. 3 armatures of relay 717 and prepares to lock itself over its own No. 1 contacts to the No. 1 front contacts of relay 714 as explained hereinafter.

The outgoing trunk to tandem is connected to a tandem sender 710 of the type shown and described in the above-mentioned patent to T. H. Roberts and when this connection has taken place as therein described, the local sender 560 transmits the called number into said tandem sender 710 by means of what are known as call indicator pulses, which are groups of four pulses per digit to set the registers in the tandem sender in accordance with the called number. These pulses are light negative pulses, heavy negative

pulses and light positive pulses. There is a switch in the local sender 560 which, upon connection with receiving relays in the tandem sender 610, rolls through two complete revolutions, during which it produces a set of four pulses per digit, transmitting the same over the line conductors into the tandem sender 710.

Bridged across the line between relays 701 and 717 are two conductors, namely 720 and 719 which, through the No. 6 and No. 7 contacts of relay 605 in the connector, extend to the grids of vacuum tubes 608 and 609, respectively, as already described. The anode of tube 608 extends with its positive battery 612 serially through the lower windings of relays 622, 623 and 624, while the anode of tube 609 extends serially to the same battery through the upper windings of said relays. Relay 624 is a marginal relay and responds only to heavy negative impulses; relay 622 is a negatively polarized relay and responds only to negative pulses while relay 623 is a positively polarized relay and responds only to light positive impulses. As the call indicator pulses are transmitted from local sender 560 to tandem sender 710 they affect the grids of vacuum tubes 608 and 609 in a manner to make them conducting when the respective grid biases are altered in response to the presence of negative battery on the associated conductors. When either or both tubes operate, one or more of the relays 622, 623 and 624 will operate in the anode circuit of the tube thus affected so that, as the called indicator pulses are transmitted into tandem sender 710, they will affect tubes 608 and 609 as well as the relays in their respective anode circuits to record the called number on the registers shown on Figs. 8 and 10.

To illustrate how the called number will be recorded in the registers of the connector, let it be assumed that the called subscriber's number is Chelsea 5678, in which event and according to the teachings of the above-mentioned patent to Roberts, eight groups of call indicator pulses in accordance with the following code will be transmitted from local sender 560:

	Reg.	Sta.	Th.	Pulses			
	0	0	0				
	1		2	Light positive...	Light negative...		Light negative.
	2	W	4	do.	do.		Do.
C	3	R	6	Heavy negative...			Do.
E	4	R	6	Light positive...	do.		Do.
	5	J	8	do.	Light negative...	Light positive...	Do.
H	6	M	1	do.	do.		Heavy negative.
	7		5	Light positive...	do.		Do.
	8		7	Heavy negative...	do.		Do.
	9		9	Light positive...	do.		Do.
				Light negative...	Light positive...		Do.

The first code impulse which, as shown above, is a heavy negative one, causes the operation of tube 608 and, therefore, operation of relays 622 and 624. Relay 622, in operating, connects ground on conductor 611 from the back contacts of relay 1036, over its front contact, No. 1 back contacts of relay 634, winding of relay 632, left winding of relay 634 to battery. Relay 632 operates but relay 634 does not on its left winding in series with relay 632. Furthermore, upon the operation of relay 632 ground is connected over the left contacts of said relay to one side of the right winding of relay 634, ground being connected to its other side by the pulsing ground through the left back contacts of said relay. In consequence of this short circuit of its active winding, relay 634 is prevented from operating at this time. Relay 624, in operating, connects

ground on conductor 611 over its front contact, No. 3 back contacts of relay 634, conductor 610, No. 3 back contacts of relay 807, right winding of relay 804 of the tandem digit A register 800 to battery. Relay 804 operates and then locks through its left winding to conductor 841 which is grounded at the No. 1 contacts of relay 613. When the pulse terminates, vacuum tube 608 restores and relays 622 and 624 release. Relay 622, in releasing, removes the shunt around the active winding of relay 634 which now operates in series with its two windings. With relay 634 operated, a circuit is closed for relay 807 extending from battery through the winding of said relay, No. 2 back contacts of relay 806, conductor 839, No. 2 contacts of relay 634, conductor 611, back contacts of relay 1036 to ground. Relay 807 operates and locks through the winding of relay 806, No. 2 contacts of relay 807, conductor 841 to ground, but relay 806 does not operate in this locking circuit inasmuch as it is shunted by the operating ground for relay 807 until relay 634 releases as subsequently described. The next pulse received is a light negative pulse, the quantity of current flowing through the anode circuit of tube 608 is correspondingly smaller, and, therefore, relay 622 operates alone whereupon it closes a circuit extending from ground on conductor 611, contacts of relay 622, No. 1 front contacts of relay 634 to the winding of relay 632 over one branch of the relay network and to the left winding of relay 634 over the other branch of the relay network. Since ground is connected to the other side of the winding of relay 632 via the active winding of relay 634 and the left contacts of relay 632, said relay releases causing thereby relay 634 to hold over its left winding to pulsing ground until the pulse terminates at which time said relay releases and disconnects ground from conductor 839 and thereby removes the shunt around the winding of relay 806 causing said relay to operate in the locking circuit of relay 807. Relays 806 and 807 transfer the circuits controlled by relays 622, 623 and 624 to the tandem digit B register 810. It is apparent that

only relay 804 has been operated in the tandem digit A register 800 by the group of pulses for the first tandem digit.

During the reception of the first pulse of the next digit, which is a light negative pulse, relay 622 is operated alone as above described and, in turn, operates relay 632 in the manner already set forth. At the end of the pulse, relay 634 is operated in series with relay 632 closing thereby a circuit for relay 817 which extends from battery through the winding of relay 817, No. 2 back contacts of relay 816, No. 2 front contacts of relay 806, conductor 839, No. 2 contacts of relay 634, to grounded conductor 611. Relay 817 operates and locks through the winding of relay 816 which, in the meanwhile, is held shunted by ground on conductor 841 and ground on conductor 839, the latter being applied to the winding through the No. 2

back contacts of said relay. The second pulse of this digit is a positive pulse and causes the operation of vacuum tube 609 and the consequent operation of relay 623. Relay 623 closes a circuit from ground on conductor 611 over its front contact, right front contacts of relay 632, conductor 614, No. 5 front contacts of relay 806, No. 5 back contacts of relay 816, right winding of relay 812 to battery. Relay 812 operates and then locks through its left winding to grounded conductor 841. The fourth pulse of the digit which is light negative (the first pulse being assumed to be blank in the place of a positive pulse in its place) causes the operation of relay 622 which releases relay 632. The end of the pulse causes the release of relay 634 as previously described thereby permitting the operation of relay 816 in the locking circuit of relay 817. The pulse group of the second tandem digit has resulted in the operation and locking of relay 812 of register 810.

The first pulse of the third tandem digit is a positive pulse. A circuit therefore is closed which extends from ground at the contact of relay 623 via conductor 611, right back contacts of relay 632 which has not been operated as yet, conductor 615, No. 1 front contacts of relays 807 and 817, No. 1 back contacts of relay 827, right winding of relay 821 to battery. Relay 821 operates and then locks through its left winding to ground on conductor 841. The second pulse, which is a heavy negative pulse, causes the operation of relays 622 and 624 as previously described. Relay 624 closes a circuit from grounded conductor 611 through its own contacts, No. 3 back contacts of relay 634, conductor 610, No. 3 front contacts of relays 807 and 817, No. 3 back contacts of relay 827, the right winding of relay 824 to battery. Relay 824 operates and then locks to ground on conductor 841. The operation of relay 622, in response to this pulse and to the following light negative pulse, causes the operation and release of relays 632 and 634 and thereby brings about the operation and locking of relays 826 and 827 in the same manner as the previous two sets of steering relays 806 and 807, and 816 and 817. Relays 821 and 824 are, therefore, operated in the tandem C register 820 to record the designation of the letter E of the called subscriber's number.

Assuming that the called subscriber's number includes no stations digit, the pulse code of the next digit received will consist of two light pulses which are the equivalent of the digit zero. No register relay in the ten thousands or stations register 830 will be operated, but the steering relays 836 and 837 will be operated in response to the operation of relay 622, to advance the circuit to the next or thousand's digit register 1000.

The remaining digits are recorded in a similar manner on registers 1000, 1010, 1020 and 1030 and result in the operation and locking of relays 1003 and 1004 in the thousands register 1000, relays 1011 and 1013 in the hundreds register 1010, relays 1024 and 1023 in the tens register 1020 and relays 1031, 1033 and 1034 in the units register 1030. Any other number will be recorded in the above registers in accordance with the above-mentioned pulse code.

For purposes of closing through a two-wire office selector (not shown) which may sometimes be included in the train of selectors extending between the calling and the called offices, the local sender 560 is adapted to transmit, after the numerical pulse code, a heavy positive pulse, to cause the operation of a polarized relay in said two-wire selector as a signal to prepare the talk-

ing conductors therein for the transmission of conversation thereover. Such a pulse would cause the activation of vacuum tube 609 and the operation of the marginal pulse relay 624 and the positive polarized relay 623. However, since ground on conductor 611 is applied to the armature of these relays through the back contact of relay 1036 which is operated at the time relays 623 and 624 operate in response to the transmission of the heavy positive pulse, their operation will have no effect. Following the transmission of the final heavy pulse, the sender 560 is disconnected from the district selector 550 in the manner described in the above-mentioned Raymond-Scully patent.

As each digit of the called number is recorded in each of the separate registers 800, 810, 820, etc., it is immediately caused to be printed upon a tape controlled by the recording mechanism 730 which constitutes a part of the outgoing trunk and which may be of any suitable type. The recording operations are controlled by the rotary switches 900, 910, etc., 1100, 1110, etc., which are associated respectively with registers 800, 810, etc., 1000, 1010, etc. Hence when the register 800 has been operated to register the pulse code of the letter C of the office name, a circuit is completed for relay 906 which extends from ground on the No. 1 contacts of relay 806, No. 1 contacts of relay 808, conductor 908, winding of relay 906, conductor 909, brush 616 of switch 640 and the first terminal accessible thereto, to battery. Relay 906 operates and closes its contact by which the ground on conductor 908 is applied to the winding of the stepping magnet 901 of switch 900 through the interrupter contacts of said magnet. Magnet 901 operates and steps the switch brushes 902 to 905, inclusive, one terminal whereupon a circuit is completed for the winding of the type wheel magnet 702 of the recording equipment, said circuit extending from ground on brush 902, conductor 907, No. 3 contacts of relay 613, No. 9 contacts of relay 605, conductor 619, winding of type wheel magnet 702 to battery. The magnet operates, closes an obvious circuit for slow-to-release relay 703 and advances the type wheel 704 one notch to register one pulse. When stepping magnet 901 operates it, of course, breaks the operating circuit through its own interrupter contacts whereupon the magnet releases and advances the brushes of switch 900 to the next or third terminal. Now if the first digit registered in register 800 is a zero, which means that no relays in the register are operated, then with brush 903 on the zero terminal (so labelled), a circuit will be completed for relay 808 which extends from battery through the winding of said relay, conductor 809, brush 903 and zero terminal of its arc, conductor 918, No. 4 back contacts of relay 801, No. 3 back contacts of relay 802, No. 4 back contacts of relay 803, No. 2 back contacts of relay 804, No. 1 contacts of relay 806 to ground. However, since, in illustrating the establishment of the connection, it has been assumed that the first number of the digit registered in register 800 is that corresponding to the letter C and hence in the pulse code as given corresponding to digit 2, no such circuit will be completed for relay 808 which means that the circuit for relay 906 is still effective so that, upon the release of stepping magnet 901 at which time the brushes of the switch 900 are advanced another terminal, the circuit of said magnet is completed once more over the previously described path and the brushes 902 to 905 are therefore advanced to the next terminal. In this position of the brushes, brush 902 will be in contact with terminal 4 of its

arc, the previously described circuit for magnet 702 is again completed whereupon said magnet again operates to advance the wheel 704 another notch to record a second pulse. The operation of magnet 702 again closes the obvious circuit for relay 703, which relay is maintained in an operated position between pulses due to its slow-to-release characteristics, and, upon the advance of switch 900 by the release of its magnet 901 as previously described, magnet 702 releases. Since relay 703 is in an operated position at this time, a circuit is completed for the printing and advance magnet 705, which circuit extends from battery through the winding of said magnet, contacts of relay 703, normal contacts of magnet 702 to ground. The printing magnet operates and causes the printing of the second pulse upon the tape.

With switch 900 in position 4 and with the digit 2 registered in register 800, as is evidenced by the operated condition of relay 804, switch 900 transmits another pulse to magnet 702 which is then recorded by the operation of magnet 705, advances its brushes to the next terminals beyond which brush 902 transmitted the third pulse, and a circuit is then completed for relay 808 which extends from battery through the winding of said relay, conductor 809, brush 903, and terminal 2 (so designated) on the arc accessible thereto, conductor 917, No. 3 back contacts of relay 803, No. 2 normally made contacts of relay 801, No. 2 front contacts of relay 804, to ground on the No. 1 front contacts of relay 806. Relay 808 operates, opens the circuit of relay 906 and completes that of relay 621 and magnet 625 of switch 640, which circuit extends from ground on the No. 2 front contacts of relay 808, conductor 815, No. 4 back contacts of relay 613, normal terminal and brush 617, winding of relay 621 to battery and, in parallel therewith over the back contact of said relay, to the winding of magnet 625 of the stepping switch 640. Switch 640 is of the forward stroke type, well known in the signaling arts, and advances its brushes upon the operation of its driving magnet (as contrasted with the switch 900, for example, which is of the "back stroke" type and advances its brushes in the release of its driving magnet) so that, when magnet 625 operates, it causes brushes 616 and 617 to step from the first terminal to the second terminal of their respective cooperating arcs, whereupon the circuit for relay 621 is broken, that of the magnet 625 having been broken previously at the contacts of said relay, and thereby causing said relay to release. Relay 621 releases and since magnet 625 is already released, brushes 616 and 617 remain upon the terminals to which they have been stepped. With the brushes of switch 640 on terminal 2 of their respective arcs, the circuit is ready for causing the printing of the pulses of the second digit of the called office name if the same have been registered in register 810. If, by the time the pulses of the first digit have been recorded upon the tape, the second digit has not yet been received from the sender, the connector will wait until said digit is registered in register 810, which registration will then be evidenced by the operation of relays 816 and 817, at which time a circuit is completed for relay 916 which extends from ground on the No. 1 contact of relay 816, No. 1 contact of relay 818, conductor 919, winding of relay 916, conductor 927, brush 616 and second terminal upon which it is standing, to battery. Relay 916 operates in said circuit and applies operating ground through its own contacts and the interrupter contacts of the stepping magnet 911 of switch 910 to form a com-

plete circuit through the winding of said magnet, to battery. Magnet 911 operates and steps the brushes 912 to 915, inclusive, from their respective first terminals to their respective second terminals, in which positions a ground pulse is transmitted to the magnet 702 over a circuit which extends from ground on the second terminal of the arc associated with brush 912, and thence as previously traced to the winding of magnet 702, causing said magnet to advance the type wheel the equivalent of one pulse. The magnet operates, closes its contacts and, as before, causes the operation of relay 703. Upon the release of said magnet 702, the previously traced circuit of the recording magnet 705 is completed, said magnet is operated and a pulse mark is made upon the tape. In the same manner as described for the transmission of the pulse corresponding to the first digit as recorded in register 800, an equivalent number of pulses will be transmitted by brush 912 to the magnet 702 for the advance of the type wheel 704 an appropriate number of pulse spaces (four spaces) corresponding to the letter H and the consequent operation of recording magnet 705, as described, an equal number of times (four times) to record that many pulses on the tape.

When the pulses for the letter H have been transmitted to magnet 702, a circuit is completed for relay 818 which is traced from battery through the winding of said relay, conductor 928, brush 913 and cooperating terminal No. 4, conductor 929, No. 3 front contacts of relay 812, No. 4 back contacts of relay 813, No. 2 back contacts of relay 814, to ground on the No. 1 front contacts of relay 816. Relay 818 operates and performs the same functions for switch 910 which was performed by relay 808 for switch 900; that is, it opens the circuit of relay 916 and completes that of stepping magnet 625 and relay 621 over the No. 2 terminal to which brush 617 is now connected, causing said magnet and said relay to operate and step the brushes 616 and 617 of said switch to the third terminal, respectively, in which positions the connector is ready to transmit the pulses corresponding to the third digit of the office name as recorded on register 820 if the same has been received from the sender.

It is not believed necessary to detail the operation of each one of the remaining switches 920, 930, 1100, 1110, etc., as they operate to cause the recording on the tape controlled by magnets 702 and 705 of the required number of pulses corresponding to each of the digits of the called number, as all operations are identical with those already described except for the fact that the brushes of each of the switches will be stepped, in pulsing, to the terminals which correspond to the number of pulses recorded in the correlated register of Figs. 8 and 10 and will remain there until the last or units pulses of the called number are recorded upon the tape, at which time relay 1038 is caused to operate over a circuit extending from battery through the winding of said relay, brush 1133 and terminal No. 8 of the arc, conductor 1107, No. 2 front contacts of relay 1033, No. 2 front contacts of relay 1031, No. 2 front contacts of relay 1034 to ground on the No. 1 front contacts of relay 1036. Relay 1038 operates, breaks the circuit of relay 1136 and completes that of relay 621 and magnet 625, said circuit being traced from ground over the No. 2 front contacts of relay 1038, conductor 1117, brush 617 and cooperating terminal, winding of relay 621 and, in parallel therewith over the back contacts of said relay, to the winding of stepping magnet 625

to battery. Switch 640 steps in consequence of the operation of magnet 625 and brushes 616 and 617 are advanced to their first terminal. Relay 1038 also completes another circuit which extends from ground through the No. 3 contacts of said relay, conductor 1119, winding of relay 613 to battery. Relay 613 operates and locks over its No. 2 contacts to ground on the No. 1 contacts of relay 605, disconnects ground from conductor 841 thereby causing the locked relays in the registers of Figs. 8 and 10 to unlock and release, including relays 808, 818, etc., and 1008, 1018, etc., breaks the path to the magnet 702, further opens a set of contacts in the path of relay 621 and magnet 625, and further connects ground over its No. 5 contacts to conductor 642. Inasmuch as all the switches shown in Figs. 9 and 11 are not normal because of the different setting taken by each of them when transmitting the pulses of the called number to the magnet 702, brushes 904, 914, etc., and 1104, 1114, etc., will be on the commoned portion of their respective arcs whereupon, upon the release of relays 808, 818, etc., and 1008, 1018, etc., separate driving circuits are completed to the winding of the magnet of each of the switches 900—930 and 1100—1130 whereby the brushes of said switches are returned to their respective normal terminals. For instance, and by way of illustrating all of the above circuits, when relay 808 releases, a self-interrupted drive circuit is completed for magnet 901 of switch 900 which extends from ground on the No. 2 back contacts of relay 808, conductor 939, brush 904 and the commoned terminals accessible thereto, interrupter contacts of stepping magnet 901 to battery. Magnet 901 operates on self-interruptions and drives the brushes of switch 900 back to their respective normal terminals. In the same way, upon the release of relays 818—838 and 1008—1038 as above enumerated, the brushes of the corresponding switches 910—930 and 1100—1130 are restored to normal. When all of these switches are normal, a circuit is completed from ground on the No. 5 contacts of relay 613, conductor 642, serially through the brushes 1135, 1125, etc., and 935, 925, etc., conductor 938, winding of relay 626 to battery, causing said relay to operate.

With the recording of the pulses that designate the number of the called office name and number on the tape controlled by magnets 702 and 705 associated with the outgoing tandem trunk, the connector, if not otherwise engaged, is now ready to record the designation of the calling line. Each connector circuit, besides having one relay 605 for each outgoing trunk of a group, also has a relay 401 for each outgoing trunk of a group. Since all district selectors are divided into groups available to different line groups, it is also provided with a relay 415 for each of these selector groups. Hence, with the operation of relay 626, circuit operations are begun by which the connector is caused to determine the calling line designation by first energizing the relay 401 in the connector belonging to the outgoing trunk of the connection and then operating the group relay 415 marking the district selector group containing the selector connected to said trunk. Therefore, when relay 626 operates, a circuit is completed for relay 401 which is traced from ground on the contacts of relay 626, contacts of relay 627, No. 8 contacts of relay 605, conductor 438, winding of relay 401 to battery. Should any other relay 401 of any group be in an operated condition, which indicates that the connector is then occupied with

the district selector connected to the trunk marked by said other relay in receiving the calling line number of the line connected to the line-finder end of said district selector, relay 627 will be operated over common conductor 402 from ground on the No. 10 contacts of said operated relay 401, in consequence of which the circuit just described for the operation of relay 401 of the outgoing trunk shown in Fig. 7 will not be closed. On the other hand, if, when the connector is finished with its operations of recording the called line designation over one trunk and is not otherwise engaged in determining the calling line designation over another trunk, relay 627 will be released which is the signal that the connector is free to determine the calling line designation over the first trunk, commencing operations to do so by the operation of relay 401 of said trunk as above described. Relay 401 operates and then locks over its No. 3 contacts, conductor 404 to ground on the contacts of relay 301. Relay 401 operated, applies ground to its No. 4 contacts and completes a circuit over conductor 403, No. 11 contacts of relay 605, winding of relay 618 to battery. Relay 618 operates and closes an obvious circuit for relay 606 which, in operating, unlocks relay 605. Upon the release, of relay 605, relays 618 and 606 release and since relay 613 is locked to the No. 1 contacts of relay 605, relay 613 also releases, thus restoring to normal that part of the connector which handles the registering and recording of the called line number.

As already noted, the operation of relay 401 followed the operation of relay 626. Since, according to the above-mentioned Raymond-Scully patent, the district selector is in position 15 after the pulses of the called line number have been transmitted into the tandem sender 710, relay 405 is placed across the tip and ring conductors of the partly established connection with its battery and ground connection poled against district polarized supervisory relay 533. The circuit path is as follows: battery through the upper winding of relay 405, No. 1 back contacts of relay 406, No. 1 back contacts of relay 407, conductor 409, No. 6 contacts of relay 401, conductor 719, No. 2 front contact of relay 701, conductor 556, brush 551, upper right and lower left springs of cam 504, right upper winding of repeat coil 532, left contacts of cam 503, winding of relay 533, right lower winding of repeat coil 532, left springs of cam 505, brush 552, conductor 557, No. 3 front contacts of relay 701, conductor 120, No. 7 contacts of relay 401, conductor 408, No. 2 contacts of relay 407, No. 2 back contacts of relay 406, lower winding of relay 405 to ground. Relay 405 operates in this circuit but relay 533 does not. Relay 405, upon operating, operates relay 410 over an obvious circuit and then locks over its No. 2 contacts to ground on the No. 3 contacts of relay 407.

The function of relay 410 is to summon the simplex allotter 620, of which there is one furnished per office and which has accessibility to all connectors. The simplex allotter causes the connector it acts upon to send a simplex signal over the trunk conductors for the purpose of getting the district selector attached to the outgoing trunk to operate that relay 415 in the connector that marks the group of district selectors (and line finders) of which the district selector attached to the outgoing trunk in Fig. 7 is one. Issuing of the simplex signal, however, is held up until the district selector is in a position to act upon it, which is position 15 of its sequence

switch 500, in order to reduce allotter holding time, and to make the signal as readily available as possible to other connectors. One allotter is provided and one simplex signal is transmitted at a time because, if two connectors are sending simplex signals simultaneously they each would receive both group indications. Hence when relay 410 operates, it completes a circuit for relay 628 of the allotter, which circuit is traced from ground through its No. 1 contacts, conductor 411, resistance 629, winding of relay 628 to battery. Relay 628 operates and completes a self-interrupting circuit for the stepping magnet 631 from ground on its contacts, No. 3 contacts of relay 633, interrupter contacts of magnet 631, winding of said magnet to battery. Magnet 631 operates under self-interruptions until brush 638 of the allotter switch 630 engages that terminal of its arc which has ground applied thereto by relay 410 when an obvious circuit is then completed for relay 633 which, by opening its No. 3 contacts upon operation, arrests further operations of the magnet 631 and thereby causes brushes 638, 635 and 639 to come to a stop upon the terminals thus selected.

Relay 633, upon operating, further completes a circuit for relay 412 that extends from ground on the No. 1 contacts of said relay 633, brush 639, conductor 413, winding of relay 412 to battery, and another circuit for relay 406 which extends from ground through its No. 2 contacts, brush 635, conductor 414, winding of relay 406 to battery. Relay 412, which has a pair of contacts for each group relay 415, operates and applies ground to the winding of each of said relays while relay 406, upon operating, disconnects relay 405 from the trunk conductors and connects battery to both of said conductors via resistances 426 and 427, respectively, to form a simplex circuit over a path already traced which includes relay 533. In parallel with the winding of relay 533, is one element of a two-element gas-filled tube 554 to the other element of which is connected the winding of relay 555, the other terminal of the winding of said relay extending to ground. The potential on the tube, as established by the application of battery to the two trunk conductors via resistances 426 and 427, is such that the tube breaks down and becomes conducting whereupon current will flow through it and through the winding of relay 555 thus causing it to operate. Since the sequence switch 500 is in position 15, a circuit is now completed for relay 415 of the group of district selectors which includes the district selector over which the call is being established, said circuit extending from battery through resistance 559, springs of cam 564, conductor 561, winding of relay 415 to ground on a pair of contacts on relay 412, causing said relay 415 to operate.

Relay 415, upon operating, closes an obvious circuit for relay 422 which operates thereover and locks over its No. 13 contacts to ground on conductor 404, and another circuit for relay 416 which extends from ground over its upper contacts, No. 3 contacts of relay 417, winding of relay 416 to battery. Relay 416 operates and locks in series with the winding of relay 417, its own No. 2 contacts, to ground on conductor 404. Relay 417, however, does not operate at this time, it being held shunted by the ground over the upper contacts of relay 415 applied to the other side of its winding.

As there is one relay 415 in the connector for every district line-finder group to which the connector has access, so there is, in the connector,

one relay 422 for every such group, each relay 415 for one such group operating a corresponding relay 422 as above described for that group. Now the function of relay 422 is to extend into the connector the ten brushes of the line-identifying selector 110 which is located on the same frame as the line-finder switches of the district line-finder group that serves the main group of lines in which the calling line is included. The identifying selector 110 is of the same construction as the individual line-finder switches except that each of its ten brushes is adapted to engage but one terminal of each terminal set engaged thereby in the smaller subdivisions of the main group of lines served by the line-finder switches of the group. In the most general practice, line-finder frames of the type contemplated by this invention are of the so-called panel type and accommodate four hundred lines which are divided into smaller groups of forty lines, each accessible to one set of brushes of a line-finder switch, the group of such switches serving the four hundred lines being determined, of course, by the traffic density. One identifying selector 110 is thus used for one group of such line-finder switches, and the function of this selector, when seized by the connector, is to locate the sleeve terminal of the calling line which, considering that the entire main group of four hundred lines is subdivided into ten smaller groups of forty lines each, may be located in any one of the ten groups. Each brush 140—149 of the identifying selector 110 is joined by a conductor 120—129 to a brush of a commutator segment which, in turn, is joined by a conductor to one of the armature contacts of Nos. 1 to 10, inclusive, of the contact sets of relay 422 in each of the connectors. There is also provided, for the identifying selector 110, one ground commutator 108 and a pulsing commutator 107 the latter of which has forty segments in it, one for each line in a group of forty, with which a brush 109 cooperates to provide, in conjunction with brush 111, interrupted ground from commutator 108 to the conductor 112 connected to commutator 107, which conductor is connected to the armature of the No. 12 contact set of relay 422.

When relay 416 operated, it not only locked itself up in series with the winding of relay 417, as already described, but, over its No. 1 contacts, it further completed a circuit for relay 717 of the outgoing trunk, which circuit is traced from ground on said contacts, No. 2 contacts of relay 401, conductor 418, winding of relay 717 to battery. Relay 717 operates, disconnects the forward end of the trunk from the terminals thereof on the district selector frame and connects said terminals to the left windings of repeating coil 726 and its associated relay 714, the path for which is traced from conductor 556, No. 2 front contacts of relay 701, No. 2 front contacts of relay 717, left upper winding of repeat coil 726, upper winding of relay 714 to ground; and from battery through the lower winding of said relay, left lower winding of repeat coil 726, No. 3 front contacts of relay 717, No. 3 front contacts of relay 701 to conductor 557. On the district selector side, this path is joined to that already traced for relay 533 and since the current flowing through the joined paths is in a direction to operate relay 533, said relay operates and advances the district sequence switch 500 to position 16 as described in the above-mentioned Raymond-Scully patent. In this position, as will be described shortly, the connector transmits a tone current over the sleeve of the district selector

connection to the sleeve terminal of the calling line, which tone is then picked up by the identifying selector in hunting for said calling line, as explained hereinafter.

Before applying this tone, however, and before removing the simplex signal, the connector awaits evidence of the district having been advanced to position 16. This is supplied by cam 564, which is cut in position 15+15½, as it moved out of position 15. For, when the district sequence switch 500 advances out of said position, the circuit for relay 415 is opened, causing said relay to release and remove the short circuit around the winding of relay 417 which now operates in consequence and remains operated in the locking circuit of relay 416 as above described. Relay 417 closes an obvious circuit for relay 407 which operates, removes the simplex signal from the trunk and releases relay 410 which, in turn, disconnects calling ground from conductor 411 extending to the terminal of the simplex allotter. The disconnection of ground from conductor 411 causes the release of relay 433 which, in releasing, opens the circuit of relay 412 which releases and, also, that of relay 406 which also releases.

Associated with each identifying selector 110 in the connector is a rotary switch 420 which has as many terminals on its separate arcs as there are connectors. Now when relay 422 operates, if the brushes of switch 420 are not already engaged with the terminals of the connector, they are driven to said terminals as a result of the operation of relay 419 over a circuit completed from ground on the No. 15 contacts of relay 422, resistance 421, winding of relay 419 to battery. Relay 419 completes a self-interrupted circuit for stepping magnet 423 which extends from ground on the No. 1 back contacts of relay 425, contacts of relay 419, No. 1 contacts of relay 424, interrupter contacts of magnet 423, winding of said magnet to battery. Magnet 423 steps on self-interruptions until brush 429 engages the terminal on the arc having ground applied thereto from the No. 15 contacts of relay 422, at which time said ground is applied to the winding of relay 424 via brush 429, and No. 2 contacts of relay 425, causing said relay to operate and open the circuit of the stepping magnet 423 which releases in consequence and stops the brushes 428 and 429 on the terminals of the connector. Relay 424 locks over its No. 5 contacts to operating ground and completes a circuit path for relay 431 which is traced from ground on the No. 2 contacts of relay 424, brush 428 and terminal to which it is engaged, No. 14 contacts of relay 422, No. 2 contacts of relay 417, winding of relay 431 to battery. Relay 431 operates and, among other things, connects a tone potential to the terminal of the calling line over a path which extends from grounded tone source 430, condenser 432, No. 13 contacts of relay 431, No. 1 contacts of relay 401, conductor 439, No. 4 contacts of relay 701, conductor 558, brush 553, right lower and left upper springs of cam 521, front contacts of relay 525 which, as described in the above-mentioned Raymond-Scully patent is operated in position 16 of switch 500, right and left upper springs of cam 503, condenser 563, springs of cam 508, conductor 562, commutator 115 of the line-finder switch 103, brush 116 (which, in the position assumed by the line finder when engaged to the terminals of the calling line, is in contact with commutator 115), sleeve brush 117, and sleeve terminal of the line, sleeve multiple 118 to sleeve terminal 119 appearing in that portion of

the bank which is accessible to the appropriate group brush of the identifying selector 110. Relay 431 further extends each commutator of the group 130—139 of the identifying selector 110, which have already been carried through the contacts of the group relay 422, to the winding of a relay in the group of ten relays 440—449 via a separate condenser in each of the paths. A path is now closed for the up-drive magnet 121 of the identifying selector 110 which extends from battery through the winding of said magnet, conductor 122, No. 3 contacts of relay 424, No. 11 contacts of relays 422 and 431, serially through the contacts of each of the relays 449—440 to ground on the upper back contacts of relay 440. The up-drive magnet operates and causes the identifying selector brush elevator shaft to drive along the terminals of the line-finder bank until the brush (indicated) having access to the group of terminals containing the terminal of the calling line engages terminal 119 of that line. Before this terminal is reached, however, the following operations have been taking place.

As soon as the elevator shaft of the identifying selector 110 moves off normal, each of the commutator brushes engages its respective commutator surface, brush 111 engaging the surface of grounded commutator 108 and brushes 109 and 123 engaging the metallic surface of commutators 107 and 113, respectively, to each of which ground is applied since brushes 111, 109 and 123 are connected together. As a result, a circuit is completed for relay 202 which is traced from ground on commutator 108, brushes 111 and 109, commutator 107, conductor 112, No. 12 contacts of relay 422, No. 12 contacts of relay 431, conductor 203, winding of relay 202 to battery. Another circuit is also closed for relay 425 which extends from ground on commutator 119, conductor 114, winding of said relay to battery, causing said relay to operate in preparation for the performance of functions to be described in due order. Relay 202 operates, closes an obvious circuit for relay 204 which also operates and, over its No. 1 contacts, completes a circuit for relay 210 which extends from ground on said contacts, No. 1 back contacts of relay 210', winding of relay 210 to battery. Relay 210 operates and closes a locking circuit for itself through the winding of relay 210', its own inner contacts, conductor 221, No. 2 back contacts of relay 219', No. 2 back contacts of relay 222, No. 2 back contacts of relay 223, conductor 224 to ground on the No. 5 contacts of relay 302. Relay 210', however, does not operate in this locking circuit inasmuch as it is short-circuited by operating ground on the No. 1 contacts of relay 210 and locking ground on conductor 224. Relay 204, in operating, closes an obvious circuit for relay 205 which operates, locks to ground on conductor 224 over its No. 2 contacts and, over its No. 1 contacts, prepares a partial path to the 0 terminal of the arc accessible to brush 229 of switch 340 via conductor 225, No. 4 back contacts of relay 208, No. 4 back contacts of relay 209, No. 4 back contacts of relay 252 to the 0 terminal of said arc. In parallel with said path, two other paths are partially closed, namely, one path through the back contacts of relay 239 to terminal W of the arc accessible to brush 232 of switch 360 and a second path through the No. 2 back contacts of relay 238, conductor 241, winding of relay 303, conductor 304, to the last terminal on the arc accessible to brush 305 of switch 300.

When relay 425 operates as a result of the ele-

vator of the identifying selector 110 moving off normal as above described, it closes, over its No. 1 front contacts, a partial circuit for down-drive magnet 124 completed thereto over the No. 4 contacts of relay 424 when this relay releases as explained hereinafter, and, over its No. 2 contacts, it opens the operating circuit of said relay 424 which is locked, however, to ground on the No. 15 contacts of relay 422.

Now, as the selector elevator 110 moves upward with its brushes to engage the sleeve terminals in their respective banks, insulated segments are encountered by brush 109 as it moves over the surface of commutator 107. On the first insulated segment encountered by said brush, relay 202 releases, the short circuit around the winding of relay 210' is removed and this relay operates in the locking circuit of relay 210 as previously traced. On the next succeeding commutating segment encountered by brush 109, relay 202 re-operates and closes a circuit for relay 211 over a path which can be traced from ground on the No. 1 contacts of said relay, No. 1 front contacts of relay 210', No. 1 back contacts of relay 211', winding of relay 211 to battery. Relay 211 operates and locks itself in series with the winding of relay 211', which relay, however, remains short-circuited by virtue of the operating ground on one side of its winding and ground on conductor 221 on the other. On the next insulating segment encountered by the brush 109, which marks the fact that the brushes of the identifying selector have passed out of engagement with the second set of line terminals on their respective banks, relay 202 again releases, thereby removing the short circuit around the winding of relay 211' which then operates in the locking circuit of relay 211. In the same way, with each engagement of a succeeding terminal by the brushes of the identifying selector and a corresponding engagement by the brush 109 of a commutating segment on commutator 107, another counting relay in the group of relays 210-219 is operated, and when the brushes move past said terminal and the brush 109 engages the succeeding insulating segment on said commutator, the associated prime relay in the group of relays 210'-219' is operated and locked in the same manner as relays 210 and 210'. These operations continue until the brush having access to the group of terminal sets containing the calling line engages the calling line terminal 119 to which the tone potential was applied as already described, at which time an alternating current circuit is completed over the appropriate relay in the group of relays 440-449 to ground, operating said relay and opening the circuit of the up-drive magnet 121 and thereby causing the identifying selector 110 to come to a stop on the terminals thus selected.

In order to record the designation of the calling line number as evidenced by the number of the selector brush that picked up the tone and the number of terminals passed over by said brush before reaching the terminal having the tone potential applied thereto, there is provided six rotary switches 310-360 which are adapted to operate one after the other and each to a desired point. As each of these switches rotates over circuits shortly to be described, pulses are transmitted to the magnet 702 which cause it to advance a corresponding number of spaces and, in combination with recording magnet 705 and relay 703, each space advance of the wheel 704 is recorded as a pulse, thus producing a record of the number of pulses which, as will be shown, corre-

sponds to the terminal location of the calling line. This pulsing is done over circuits to be shortly described, and the same system of pulsing is used for the calling line designation as was used for the called number, that is, one pulse for 0, two pulses for 1, and so on to ten pulses for the digit 9.

As already stated, the pulses recorded are those which identify the terminal location of the line on the line-finder frame, plus a group of pulses which indicate, in the case of two-party lines, whether the calling party is the J party or the W party. The switches involved in this line identification function are switches 310 and 320 which give the tens and units digits of the line-finder group, switch 330, which gives the number of the brush that contacted the tone path and, therefore, the bank number of the line terminal; switches 340 and 350 which give, respectively, the tens and units digits of the terminal number of the line within its group of forty; and, finally, switch 360 which indicates by its position whether party J or party W (party W including direct lines) is calling.

As already explained, relay 422 is correlated to the particular identifying selector 110 that has access to one main group of lines on one or more line-finder frames one of which contains the calling line. Let it be assumed that this main group is the 18th group. Conductor 224, which is grounded by the No. 5 contacts of relay 302, extends via the No. 16 contacts of relay 422 to conductor 433, which further extends to the No. 1 terminal of the arc accessible to brush 226 of switch 310 and multiples to all other relays 422 for line-finder groups having the digit 1 in their tens digits. Conductor 434, which also has ground applied to it from conductor 224, but via the No. 17 contacts of relay 422, extends to the No. 8 terminal of the arc accessible to brush 227 of switch 320 and also multiples to the only other relay 422 which serves line-finder groups having a number 8 in their respective tens digit. Other terminals of the arcs associated with brushes 226 and 227 are wired, respectively, to other relays 422 of the connector, the particular relay 422 for the various terminals being those that will stop the two switches after they have sent out the proper number of pulses that will correspond to the tens and units digits of whatever line-finder group in which the calling line is located.

Hence, when ground is applied to conductor 433, a circuit is completed for relay 312 which extends from ground on said conductor, resistance 242, No. 2 contacts of relay 233, conductor 244, winding of relay 312, conductor 370, normal terminal and brush 305 of switch 300, to battery. Relay 312 operates and closes its contacts to complete a self-interrupted drive circuit for stepping magnet 313 of switch 310 which steps the brushes thereof to the next terminal where brush 319 applies ground to conductor 314 thereby completing a circuit over the No. 3 contacts of relay 302, conductor 315, No. 5 contacts of relay 401, conductor 436, conductor 619, winding of magnet 702 to battery. Magnet 702 operates as before described, to advance the wheel 704 one space, relay 703 operating as before to prepare the circuit of recording magnet 705 on the release of magnet 702 to record one pulse.

Inasmuch as nothing has occurred to disturb the drive circuit of magnet 313, said magnet operates once again to advance the brushes of switch 310 another terminal, which is the 0 terminal on the arc associated with brush 226. As brush 319 leaves its terminal, the circuit of magnet 702 is

released and the circuit of the recording magnet 705 is completed, causing thereby the recording of one pulse which, without any succeeding other pulses, would designate a 0 pulse. In the 0 position of switch 300 as indicated by designation of the terminals on the arc accessible to brush 226, no pulse is transmitted to magnet 702 inasmuch as no ground is then available on brush 319, but when the brushes advance to the succeeding terminal a pulse is transmitted, these operations continuing until brush 226 has advanced to the terminal marked "1" to which ground is connected by conductor 433 as before described, whereupon a circuit is completed to the winding of relay 233 which operates to open, at its No. 2 contacts, the circuit of relay 312, thereby preventing the stepper magnet 313 from taking another step and, over its No. 1 contacts, to complete parallel circuits to relay 325 and stepper magnet 324 of forward stepping switch 300, which circuit extends from ground on the No. 1 front contacts of relay 233, conductor 245, No. 1 contacts of relay 302, normal terminal and brush 306, to winding of relay 325 and, in parallel therewith through its contacts, to the winding magnet 324 to battery. Both the relay and magnet operate, the latter causing brushes 305 and 306 to step one terminal and the former opening the circuit of the magnet to prevent its further operation. In position 1 of brush 226, no pulse is transmitted to magnet 702 which, on releasing from the pulse transmitted in the previous position of the switch, (that is, in position 1 of brush 319) completes a previously traced circuit for magnet 705 which now operates as before to cause the printing of an additional pulse, thus making two pulses, the 0 pulse and the 1 pulse.

With the brushes of arcs 305 and 306 in position 2, and with ground on conductor 434, a circuit is completed for relay 322 by way of resistance 246, the No. 2 contacts of relay 234, conductor 247, winding of relay 322, second terminal of arc accessible to brush 305 to battery. Relay 322 now operates and completes the circuit of stepper magnet 323 of switch 320, which circuit is similar to that of magnet 313. As in the case of said last-mentioned magnet, magnet 323 now steps its associated brushes one terminal at a time, transmitting with each alternate terminal on the arc accessible to brush 329 a pulse to magnet 702 and closing a circuit for relay 234 when the brush 227 reaches the terminal marked "8." Eight pulses will be recorded by the magnet 705 in the manner previously described.

The operation of relay 234 opens, at its No. 2 contacts, the circuit of the step magnet 323 and closes, at its No. 1 front contacts, the circuit of relay 325 and magnet 324 which now operate as previous sets of relays and magnets to advance the brushes 305 and 306 to terminal 3 of their respective arcs. A partial path is now completed to the winding of relay 332, which extends from battery through brush 305 and the third terminal on the arc, winding of relay 332, conductor 307, through the No. 2 contacts of relay 235 to conductor 248. Now, depending upon which relay in the group of relays 440—449 was operated in response to the one brush on the identifying selector 110 which engaged the sleeve terminal 119 having the tone potential thereon, ground on conductor 224 will be connected by said relay over its No. 1 contacts to one of the ten conductors included in the bracket line 326, each of which conductors extends to one of the terminals of the arc accessible to brush 228 in the numerical order

which designates each of the ten brushes of the identifying selector, with the conductor corresponding to the 0 brush on terminal 0 and that of brush 9 on terminal 9, the intervening conductors being spaced therebetween. Thus, if it be assumed that brush 149, which is the topmost or 9th brush on the identifying selector 110, is the one that picked up the tone, which means that the calling line is located in a group of terminals of the 9th bank, then relay 449 will have been operated and the circuit for relay 332 will have been completed through resistance 249, No. 2 contacts of relay 235, conductor 315, winding of relay 332, and thence as traced to battery through the third terminal of the arc engaged by brush 305. Relay 332 operates and completes the circuit of stepper magnet 333 which now drives its brushes over their respective arcs, transmitting pulses to magnet 702 through brush 339 until brush 228 engages terminal 9 at which time the circuit of relay 235 is completed from ground connected to the left side of resistance 249. Nine pulses are thus transmitted to magnet 702 which, operating and releasing on each pulse in combination with relay 703 and recording magnet 705, causes said nine pulses to be recorded on the tape. As in the case of the two previous switches 310 and 320, the circuit of the stepping magnet 333 is opened and that of the relay 325 and magnet 324 closed subsequent to the transmission of the appropriate number of pulses, whereupon brushes 305 and 306 are advanced to the fourth terminal.

Terminal indication within the bank is supplied by switch 340 for the tens digit and switch 350 for the terminal units digit. In grounding the proper terminal for these switches, relay 202 follows the interruptions coming from commutator 107 as the elevator shaft moves upwardly, and this relay causes the locking up, for each interruption, of a pair of counting relays in the two groups of counting relays 210—219'. If there is but one pulse, that is, if the elevator shaft takes but one step to reach the terminal of the calling line, relays 210 and 210' are operated and locked as already described. If, on the other hand, the elevator shaft takes ten steps to reach the terminal of the calling line, there will be ten pulses, and all the counting pairs of relays from 210—210' up to and including relays 219—219' will be operated and locked. Relay 219' releases all previously operated counting pairs except itself and relay 219 which remains locked to conductor 224.

There are, however, forty sets of terminals in each line bank group accessible to each brush since it has been assumed for the present embodiment of the invention that the main group of four hundred lines is disposed on a panel frame having nine terminal banks of forty terminal sets each so that, for a line in any bank, a maximum of forty pulses may have to be counted before the terminals of the calling line are reached. Assuming this to be the case, then on the eleventh pulse, and with relays 219 and 219' operated, relay 210 again operates over its previously described circuit. This time, however, a parallel circuit is provided for operating relay 252 which extends from battery through the lower winding of said relay, No. 3 back contacts of relay 222, No. 3 contacts of relay 219', upper contacts of relay 210 to ground on the No. 1 front contacts of relay 202. Simultaneously with the operation of relay 252 a circuit is closed for relay 251 which extends from battery through the winding of said relay, No. 1 back contacts of relay 222, No. 1 front contacts of relay 219', serially through the No. 1

front contacts of relays 218'—219' to ground on the No. 1 contacts of relay 202. Relay 226 operates and locks itself through its own contacts and the winding of relay 222 which, however, remains short-circuited so long as relay 202 is operated, that is, during the interval when brush 109 of the identifying selector remains on the commutating segment corresponding to the tenth terminal on the bank with which brush 149 is in contact. When the brush advances to the succeeding insulating segment, relay 202 releases and relay 222 operates in the locking circuit of relay 251. Relay 219' prepares, over its No. 4 front contacts, to ground the terminal No. 9 on the arc accessible to brush 231. Relay 252, however, opens this path to ground by opening its No. 3 back contacts, opens the ground path from terminal 0 of the arc accessible to brush 229 and establishes a partial path for terminal 1 on the arc accessible to brush 229 over the No. 4 front contacts of said relay, No. 4 back contacts of relay 209, No. 4 back contacts of relay 208, conductor 225, No. 1 contacts of relay 205 to the back contacts of relay 204. If, now, pulses continue to come in, the first nine links of the counting chain continue to follow them and to be released, each time leaving operated a group of three relays (besides relays 219 and 219') which register the tens group of terminals following the first, relays 252, 251 and 222 to register the second group of tens followed by relays 209, 220 and 223 to register the third group of tens, followed by relays 208, 206 and 207. The fortieth pulse leaves all chain relays operated and results in the recording of three pulses for the tens and nine pulses for the units in the manner described. Thus, again, if it is assumed that the terminal number is 27 which means that the calling line is in the third group of tens, then, when relay 202 has responded to twenty-seven pulses and releases, ground is applied to conductor 225 as above described and therefrom to the terminal "2" on the arc accessible to brush 229 via the No. 4 back contacts of relay 208 and the No. 4 front contacts of relay 209, and, also, to terminal 7 of the arc accessible to brush 231 via the No. 2 back contacts of relay 206, No. 3 back contacts of relay 208, No. 4 back contacts of relay 223, No. 3 front contacts of relay 209, No. 3 front contacts of relay 252, No. 2 back contacts of relay 218', No. 2 front contacts of relay 217' to the terminal 7. Over resistance 230 the ground on terminal 2 of the arc accessible to brush 229 completes a circuit path for relay 342 to battery on terminal 4 engaged by brush 305 of switch 300, operating said relay which then closes a driving circuit for the stepper magnet 343 of switch 340 which steps the brushes of the switch to terminals corresponding to terminal 2 on the arc accessible to brush 229 and transmitting a total of three pulses to magnet 702 which are caused to be recorded by the operation of relay 703 and magnet 705 in the manner already described. On terminal 2 of brush 229, relay 236 operates from direct ground on said brush which relay, upon operating, opens the circuit of the stepper magnet 343 and closes that of relay 325 and magnet 324 which operate to advance the brushes 305 and 306 of switch 300 to the fifth terminal as described for the previous terminals.

In the same manner as for any of the other previous switches, switch 350 is advanced to the terminal 7, so designated on arc accessible to brush 231, magnet 702 receiving seven pulses, the same being caused to be recorded by relay 703

and magnet 705, all as described for previous registrations.

The party line designation is made by connecting relay 239 to the tip of the trunk via conductor 334, the No. 1 front contacts of relay 407, conductor 409, No. 6 contacts of relay 401, conductor 719, No. 2 front contacts of relay 701, conductor 556, brush 551, upper springs of cam 501, No. 2 contacts of relay 525', tip conductor 400, commutator 120 of line-finder switch 103, to tip brush 124. Relay 239 seeks ground at the subscriber's station and if the station is party J, its ringer, with the receiver off is wired to ground in accordance with well-known practice as shown, for example, in Fig. 1. This ground completes a circuit for relay 239 over the path just traced thus causing the operation of said relay which, upon operating, grounds terminal J over conductor 225 on the arc associated with brush 232. If relay 239 remains unoperated, as it would be for party W or for a direct line in which ringer ground is not applied to the tip conductor 104, terminal W is grounded via the back contacts of said relay 239. As with previous registrations, relay 303 and switch magnet 363 operate to step the brushes of the switch 360 to terminal W or terminal J, causing magnet 702 to receive one (0) or two (1) pulses, respectively, as the case might be.

When brush 232 engages terminal W or terminal J, the ground on said terminal completes a circuit for relay 238 which operates to arrest the movement of switch 360 and, over its No. 3 contacts, completes an obvious circuit for relay 302 which operates and locks to ground on the contacts of relay 301. Relay 302, in operating, opens the pulsing conductor 314 and removes ground from conductor 224, thereby releasing relays 233, 234, 235, 236, 237 and 238. Each of these relays, in releasing, applies ground through its No. 1 back contacts to brushes 318, 328, 338, 348, 358 and 368 of their respectively controlled switches establishing thereby, over their respective commoned arcs, a local driving circuit for each switch magnet which operates to drive its switch brushes to their respective normal terminals, at which time a chain circuit is completed for relay 301 extending from battery through the winding of said relay, normal terminal and brushes 317, 327, 337, 347, 357 and 367 to ground on the No. 4 contact of relay 302. Relay 301 operates and removes ground from all remaining relays left locked up, and thereby frees the connector. With the release of relay 302, relay 301 itself releases after an interval, it having been made slow to release in order to insure that its release will be long enough to drop the circuit. With the release of relay 422, relay 424 is released and the circuit of the down-drive magnet 124 of the identifying selector 110 is completed over a previously described path completed to the No. 1 front contacts of relay 425. The magnet operates and restores said selector to normal and when brush 123 clears commutator surface 113, relay 425 releases.

As can be seen from above, the function of the connector is to cause a record to be made, by the recording equipment associated with a trunk, of the called line number and the calling line terminal number of the connection being established over said trunk. This information, however, is incomplete by itself inasmuch as the duration of the connection, when fully established, is likewise necessary for billing the call. Each outgoing trunk, therefore, must measure and record on the same ticket its own duration time independent of the connector.

In the process of establishing the connection, relay 714 is operated over the previously traced calling loop and supplies locking circuits for relays 701 and 717 over its No. 1 and No. 2 front contacts, respectively.

When the called subscriber B answers the call, the operation of a battery reversing relay (not shown) in the incoming selector causes battery and ground to be applied to the trunk conductors 715 and 716 in the proper direction to operate polarized supervising relay 712 which is connected to said trunk conductors through the right windings of repeat coil 705 and the No. 1 and No. 4 contacts of relay 717. The operation of relay 712 causes the application of ground to conductor 706 which completes a circuit for the time-of-day recording magnet 708 of the time-of-day mechanism 740, said circuit being completed over the No. 2 contacts of slow-operate and slow-release relay 713. The time-of-day recorder may be of any suitable type well known to the art and is equipped, as shown schematically in Fig. 7, with a set of recording wheels driven by a clock motor 721 that is operated by a 60-cycle current supply. After a brief interval, relay 713 also operates over the same circuit, opens the circuit of the time-of-day magnet 708 and extends ground on conductor 706, over its No. 1 contacts and the contacts of another pulse recording magnet 722, to the winding of relay 723, operating said relay. Relay 723 closes interrupted ground from interrupter 724 which furnishes ground pulses at the rate of one per second to the pulse wheel magnet 725. This magnet operates on the pulses received from the interrupter and advances its wheel in position to show elapsed time. At the end of the call, when either the calling or the called party disconnects and, therefore, either relay 714 or 712 releases, respectively, ground is applied to conductor 707 from the contacts of either relay thereby completing a circuit for the recording magnet 722 over the No. 3 contacts of relay 713 which, being slow to release, holds over for an interval after its circuit is opened by the release of relay 712 if it is the called party that restores, winding of magnet 722 to battery. The magnet operates and causes the elapsed time to be recorded.

The recording magnet 722 is equipped with a contact to release relay 723 which, in releasing, opens the interrupter connection in case the calling party disconnects first. Disconnect by the called party first operates the recording magnet 722 and later releases relay 713, opening the recording magnet circuit. In any event, relay 713 releases on disconnect by the called party and the circuit involved is restored to normal. On release of relay 714, relays 701 and 717 are restored to normal and the district line-finder selector is restored to normal as described in the above-mentioned Raymond-Scully patent.

While I have described my invention in connection with its specific application to automatic telephone equipment of the so-called panel type, it is to be understood that applications and embodiments thereof to other types of telephone apparatus may be made by those skilled in the art without departing from the spirit of the invention as defined within the scope of the appended claims.

What is claimed is:

1. In an automatic telephone system in which a connection is established between a calling line and a trunk under the control of a first register sender and in which a connection is completed from said trunk to a called line under the control

of a second register sender in response to the registration therein of the digits of said called line designation transferred thereto from said first sender, means for recording the calling and called line designations comprising recording means in said trunk, an identifying selector adapted to select a calling line, a first settable register responsive to the operation of said selector in establishing connection with said calling line, a second settable register responsive to the operation of said first register sender in transmitting over said trunk pulse codes of the called line designation registered therein, and means responsive to the setting of each of said settable registers for operating said trunk recording means for making a permanent record of the calling line designation and the called line designation as determined by the setting of said first and said second settable registers, respectively.

2. In an automatic telephone system in which a connection is established between a calling line and a trunk under the control of a first register sender and in which a connection is completed from said trunk to a called line under the control of a second register sender in response to the registration therein of the digits of said called line designation transferred thereto from said first sender, means for recording the calling and called line designations comprising recording means in said trunk, an identifying selector adapted to select a calling line, a first settable register responsive to the operation of said selector in establishing connection with said calling line, a second settable register responsive to the operation of said first register sender in transmitting over said trunk pulse codes of said called line designation registered therein, means responsive to the setting of each of said settable registers for operating said trunk recording means for making a permanent record of the calling line designation and called line designation as determined by the setting of said first and said second settable registers, respectively, and timing means in said trunk responsive to the called line answering the connection for making a permanent record of the duration of said connection.

3. In an automatic telephone system in which a connection is established between a calling line and a trunk under the control of a first register sender, in which a connection is completed from said trunk to a called line under the control of a second register sender in response to the registration therein of the digits of said called line designation transferred thereto from said first sender and in which said calling line is included in one of a plurality of groups of lines disposed on the terminals of a line-finder bank, means for recording the calling and called line designations comprising recording means in said trunk, an identifying selector adapted to hunt for and engage the terminals of said calling line on said line-finder bank, a first settable register operatively responsive to the operation of said selector for registering therein the number of the line group containing said calling line and the number of the calling line terminal within the group, a second settable register operatively responsive to the operation of said first register sender in transmitting over said trunk pulse codes of the called line designation registered therein for registering said called line designation in said second settable register, and means responsive to the setting of each of said two settable registers for operating said trunk recording means for making a permanent record of the calling line designation and

the called line designation as determined by the setting of said first and second settable registers, respectively.

4. In an automatic telephone system in which a connection is established between a calling line and a trunk under the control of a first register sender, in which a connection is completed from said trunk to a called line under the control of a second register sender in response to the registration therein of the digits of said called line designation transferred thereto from said first sender, and in which said calling line is included in one of a plurality of groups of lines disposed on the terminals of a line-finder bank, means for recording the calling and called line designations comprising recording means in said trunk, an identifying selector adapted to hunt for and engage the terminals of said calling line on said line-finder bank, a first settable register operatively responsive to the operation of said selector for registering therein the calling line group and the numerical designation of the calling line terminals in said group, a second settable register operatively responsive to the operation of said first register sender in transmitting over said trunk pulse codes of the called line designation registered therein for registering said called line designation in said second settable register, and pulsing means responsive to the setting of each of said two settable registers for operating said trunk recording means for making a permanent record of a plurality of groups of pulses indicative of the calling and called line designations as determined by the setting of said first and second settable registers, respectively.

5. In an automatic telephone system in which a connection is established between a calling line and a trunk under the control of a first register sender in which a connection is completed from said trunk to a called line under the control of a second register sender in response to the registration therein of the digits of said called line designation transferred thereto from said first sender, and in which said calling line is included in one of a plurality of groups of lines disposed on the terminals of a line-finder bank, means for recording the calling and called line designations and the duration of the connection comprising recording means in said trunk, an identifying selector adapted to hunt for and engage the terminals of said calling line on said line-finder bank, a first settable register operatively responsive to the operation of said selector for registering therein the calling line group and the numerical designation of the calling line terminal in said group, a second settable register operatively responsive to the operation of said first register sender in transmitting over said trunk pulse codes of the called line designation registered therein for registering said called line designation in said second settable register, pulsing means responsive to the setting of each of said two settable registers for operating said trunk recording means for making a permanent record of a plurality of groups of pulses indicative of the calling line and called line designations as determined by the setting of said first and second settable registers, respectively, and timed impulse means responsive to the called line answering the connection for making a permanent record of a group of pulses indicative of the duration of said connection.

6. In a telephone system, calling lines, trunks to which said lines have access, recording means in each of said trunks, an identifying selector

having access to said lines, means responsive to one of said trunks when taken into use by one of said lines for operating said identifying selector to hunt for and seize said calling line, and means for operating said recording means to record the identity of said calling line as determined by the movement of said identifying selector.

7. In a telephone system, calling lines, trunks to which said lines have access, recording means in each of said trunks, an identifying selector having access to said lines, and a connector circuit accessible in common to each one of said trunks when taken into use by one of said lines comprising means for operating said identifying selector to hunt for and seize said calling line, a settable register circuit responsive to the operation of said identifying selector for registering the movement thereof in reaching said calling line, and pulsing means responsive to the setting of said register circuit for operating said recording means to record the identity of said calling line.

8. In a telephone system, lines disposed in groups on the terminal banks of a panel frame, automatic switching selectors having access to the terminal banks of said panel frame, each of said selectors being provided with as many brush sets as there are line groups in said terminal banks for causing the engagement of the selector with any line in any group, an identifying selector provided with as many brush sets as there are line groups in said terminal banks, and a connector accessible to each of said switching selectors when taken into use by one of said lines comprising means for operating said identifying selector to hunt for and seize the terminals of the calling line, relay means responsive to the connection of one of the brush sets of said identifying selector with the terminals of the calling line for marking the brush set so connected, counting relay means responsive to the terminal movement of said identifying selector for marking the number of terminals in a bank travelled over by said identifying selector prior to reaching the terminal of the calling line, stepping switches responsive to said operated relay means and to said counting relay means for transmitting a plurality of groups of pulses indicative of the brush set of said identifying selector having access to the group of lines containing said calling line and of the numerical indication of the disposition of said calling line terminal within the line group, and recording means responsive to the operation of said switches for making a permanent record of said plurality of groups of pulses.

9. In an automatic telephone system including calling lines and a group of line-finder switches having access thereto, means for recording the numbers of the lines on which calls are originated comprising a separate line-finder switch for each group of said line-finder switches having access to said lines, means for automatically actuating said separate line-finder switch to find the terminals of a calling line, settable registers responsive to the movement of said separate line-finder switch to mark the location of the calling line, means for registering the group of said line-finder switches, and means responsive to said last-mentioned means and to the setting of said settable registers for making a permanent record of the line-finder switch group and the numerical identification of said line.

10. In an automatic telephone system, a plurality of lines divided into groups, said groups of

lines terminating, respectively, in the banks of a line-finder frame, a group of line finders on said frame having access to said lines, means responsive to any one of said lines when calling for operating an idle one of said line finders to seize said calling line, an outgoing trunk, means for connecting said operated line-finder switch to said outgoing trunk, and means for recording the numerical designation of said line comprising a line-finder group register, a brush set register and a numerical register, an identifying line finder common to said group of line finders, having a plurality of brush sets having access, respectively,

to said banks, means responsive to the seizure of said calling line by one of said group of line finders to cause said identifying line finder to seize said calling line, means in said outgoing trunk for operating said group register, means for operating said brush set register and said numerical register in accordance with the operation of said identifying line finder in seizing said calling line, and further means in said outgoing trunk for recording the operated condition of said group register, said brush register and said numerical register.

LINUS E. KITTRIDGE.

DISCLAIMER

2,370,736.—*Linus E. Kittredge*, Port Washington, N. Y. TELEPHONE SYSTEM.
Patent dated Mar. 6, 1945. Disclaimer filed Mar. 5, 1947, by the assignee,
Bell Telephone Laboratories, Incorporated.

Hereby enters this disclaimer to claims 6, 7, 8, 9, and 10 of said patent.

[*Official Gazette April 8, 1947.*]

lines terminating, respectively, in the banks of a line-finder frame, a group of line finders on said frame having access to said lines, means responsive to any one of said lines when calling for operating an idle one of said line finders to seize said calling line, an outgoing trunk, means for connecting said operated line-finder switch to said outgoing trunk, and means for recording the numerical designation of said line comprising a line-finder group register, a brush set register and a numerical register, an identifying line finder common to said group of line finders, having a plurality of brush sets having access, respectively,

to said banks, means responsive to the seizure of said calling line by one of said group of line finders to cause said identifying line finder to seize said calling line, means in said outgoing trunk for operating said group register, means for operating said brush set register and said numerical register in accordance with the operation of said identifying line finder in seizing said calling line, and further means in said outgoing trunk for recording the operated condition of said group register, said brush register and said numerical register.

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