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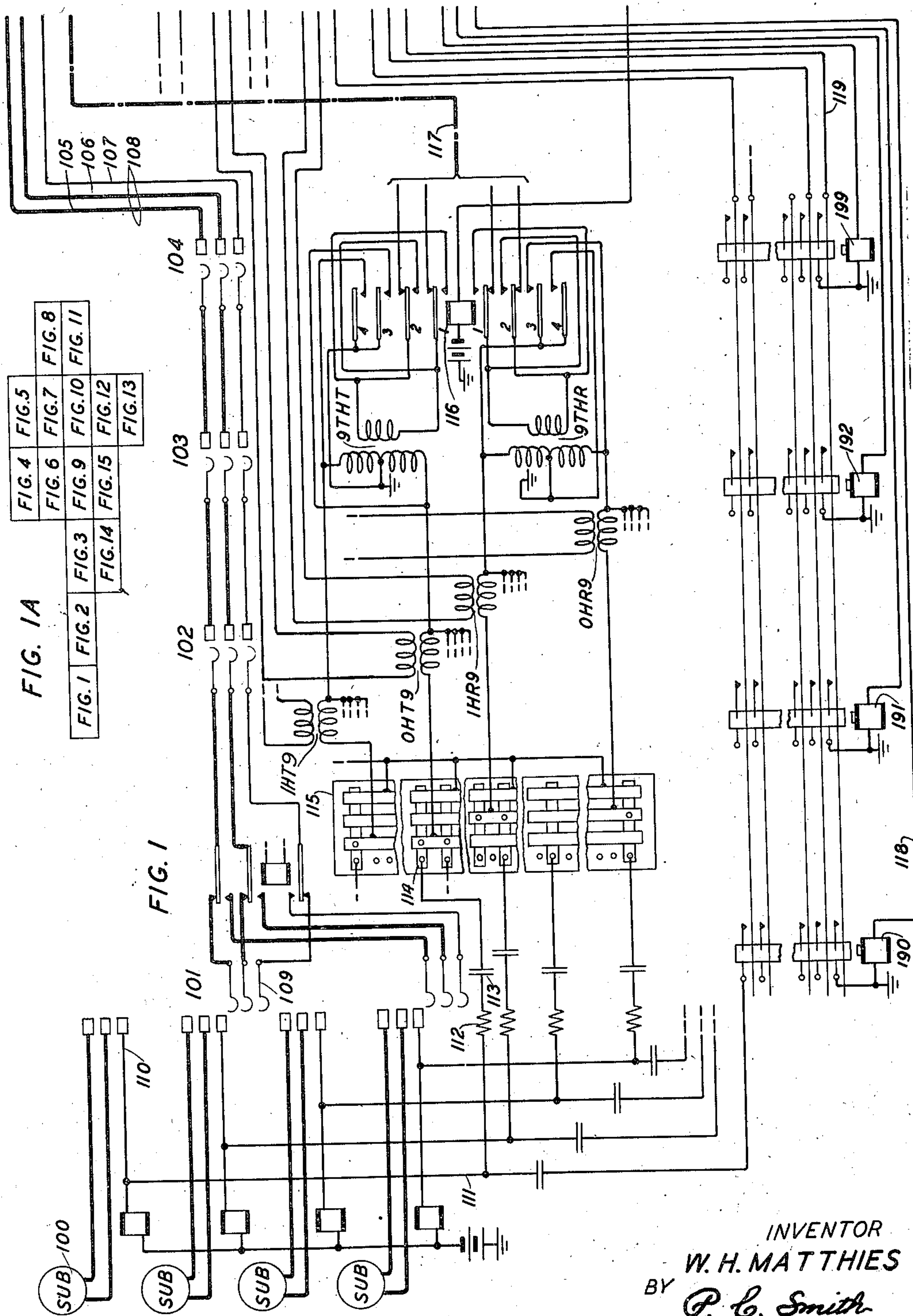
W. H. MATTHIES

2,428,376

TIME CONTROLLED REGISTER FOR AUTOMATIC TELEPHONE SYSTEMS

Filed June 12, 1943

15 Sheets-Sheet 1



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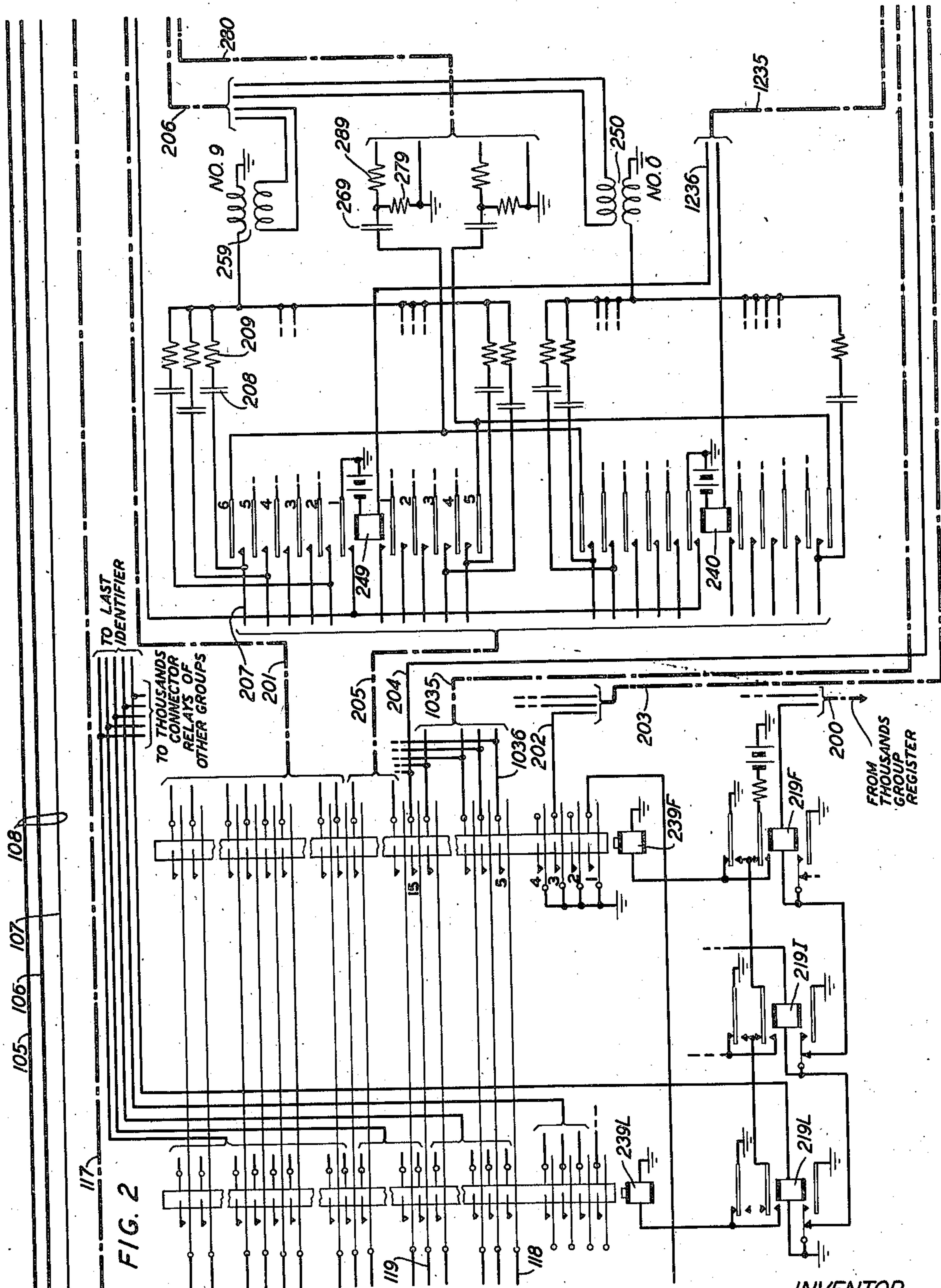
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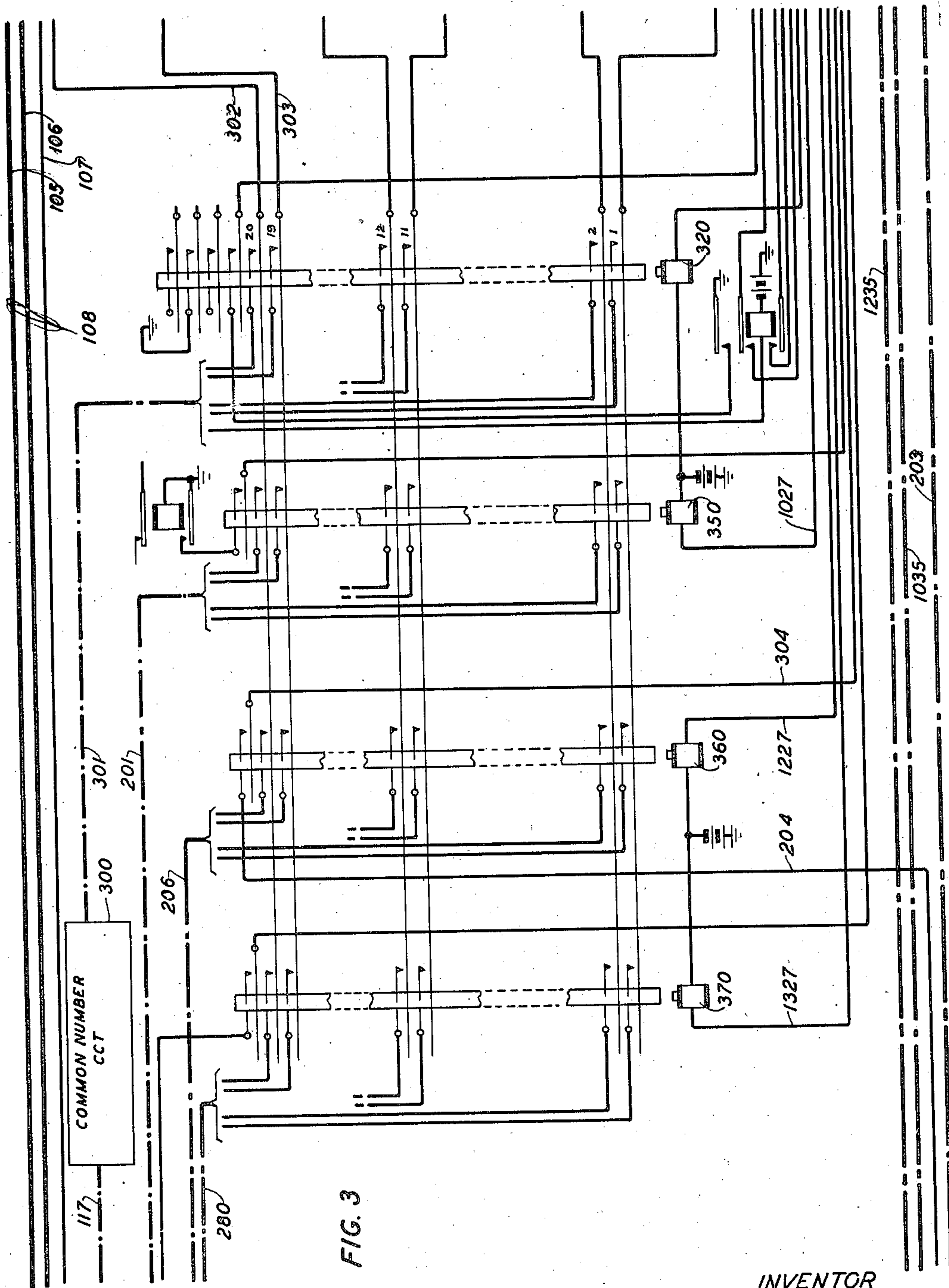
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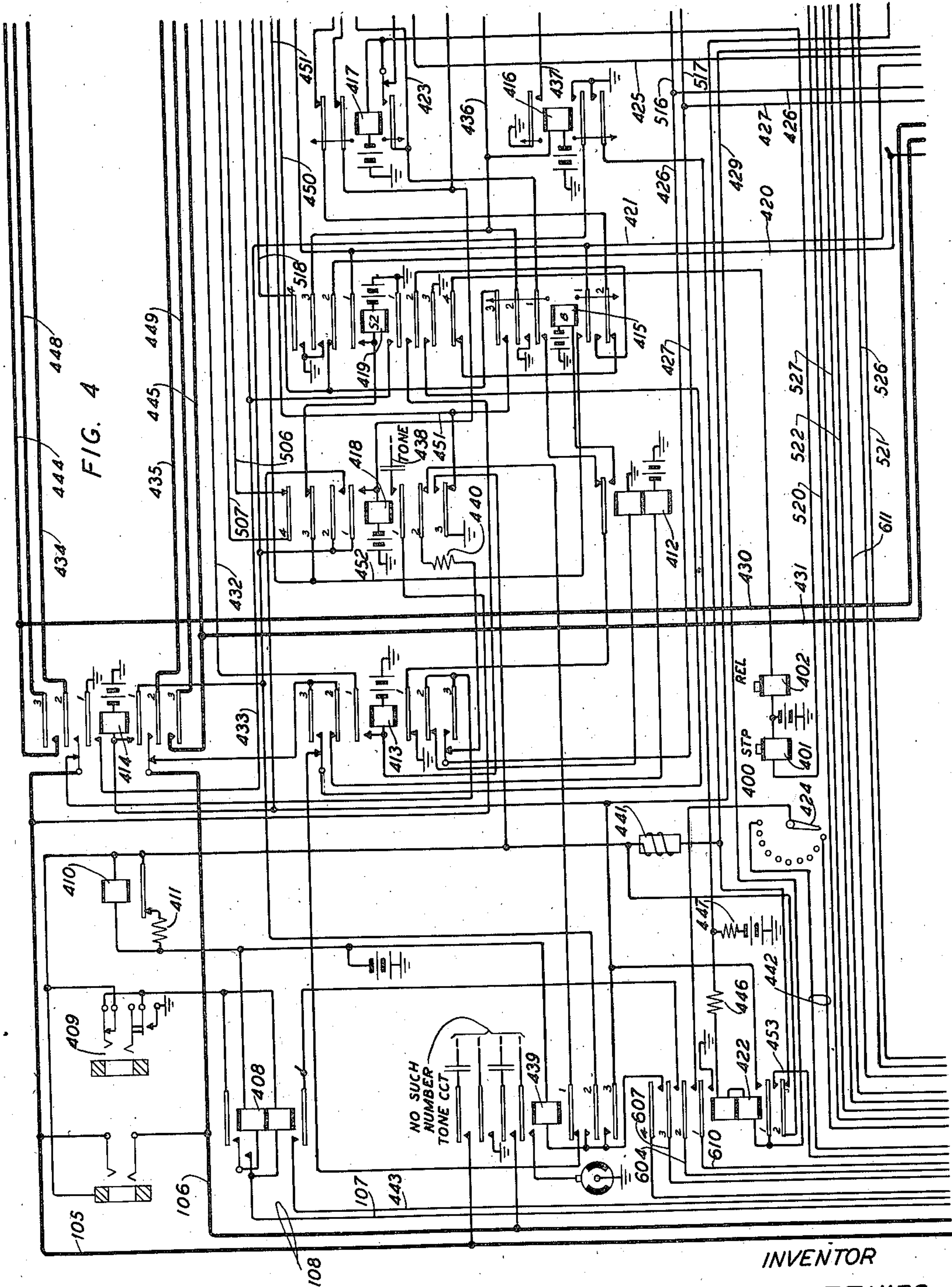
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15 Sheets-Sheet 4



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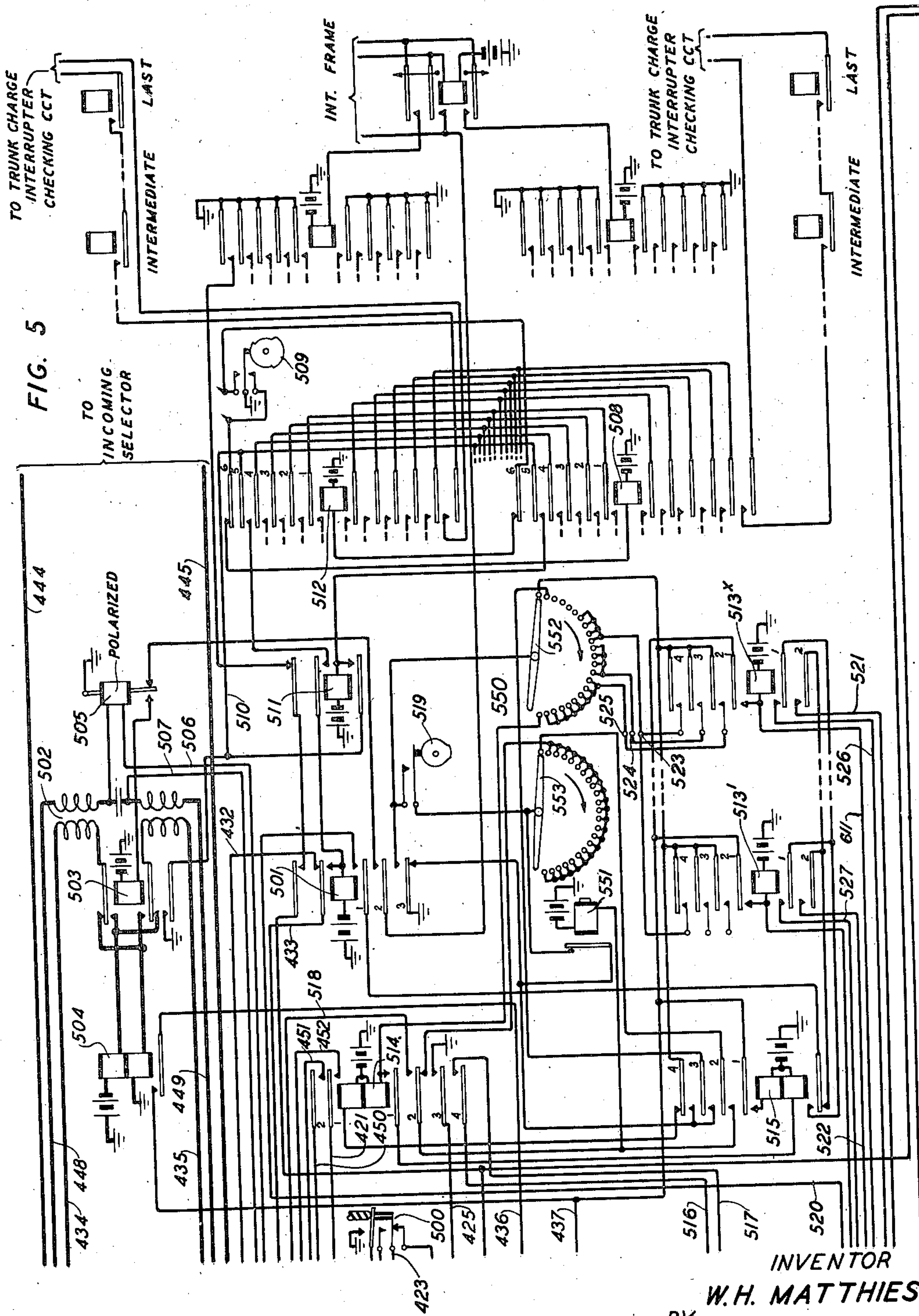
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15 Sheets-Sheet 5



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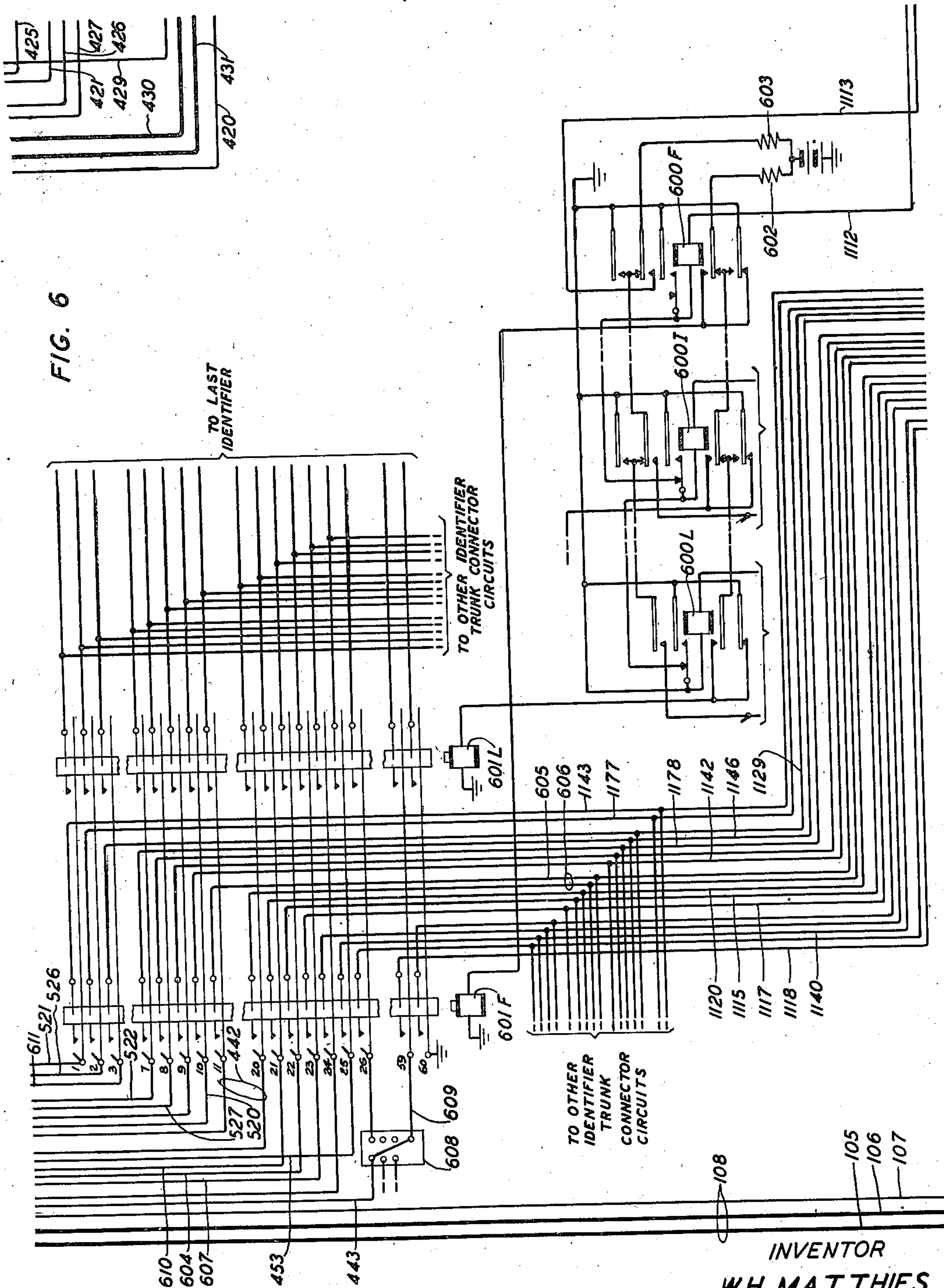
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15 Sheets-Sheet 6



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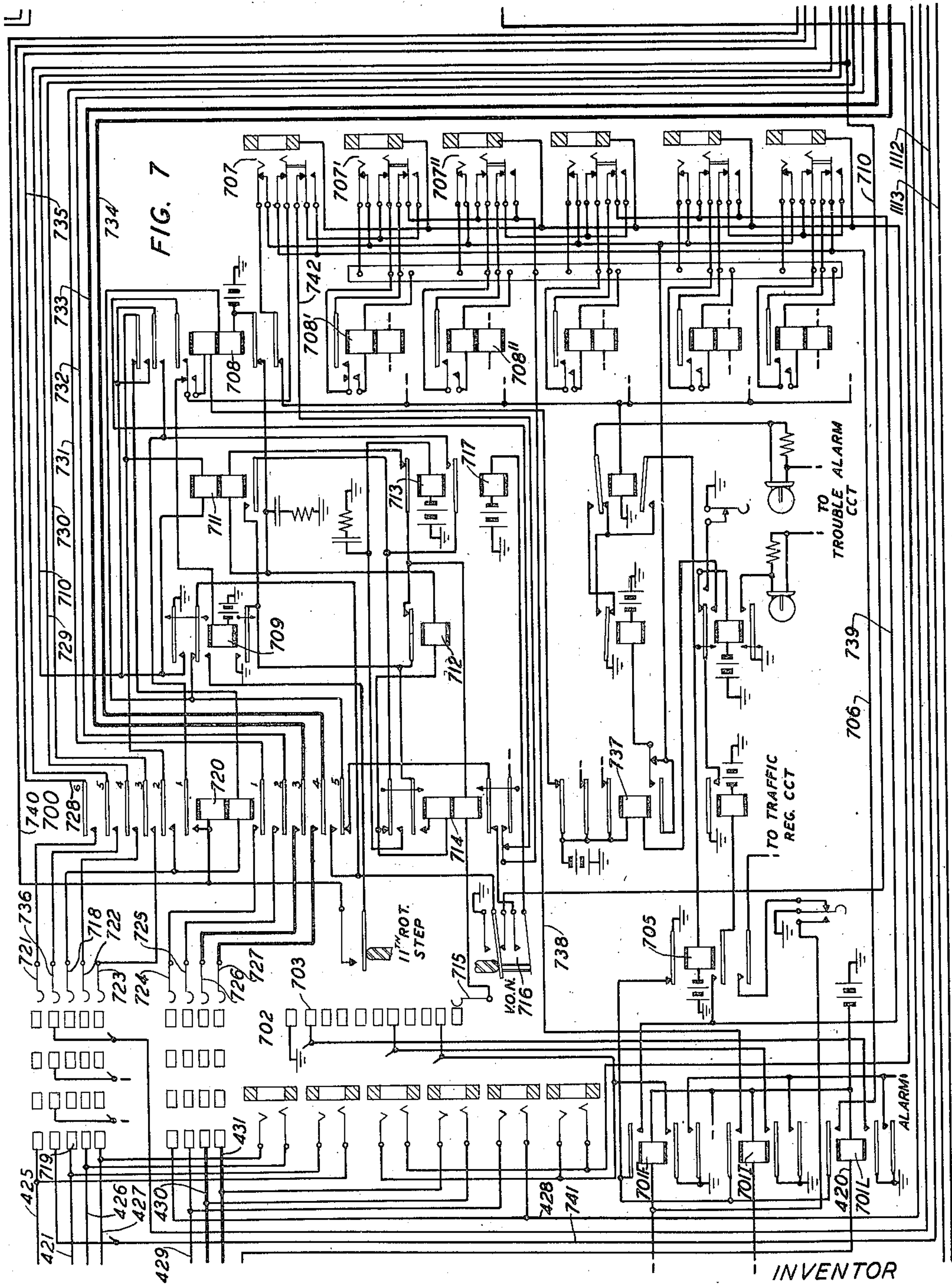
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15 Sheets-Sheet 7



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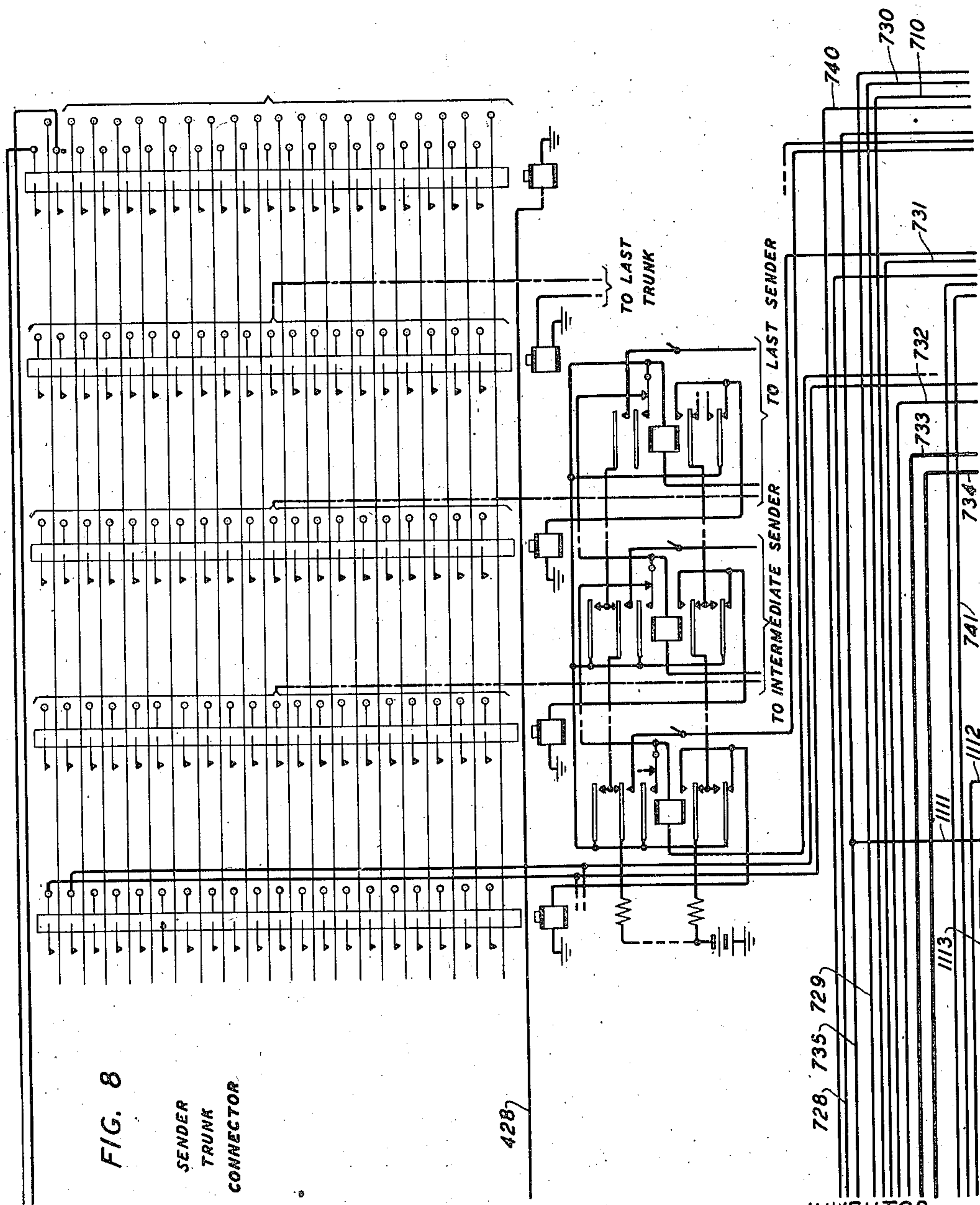


FIG. 8

SENDER
TRUNK
CONNECTOR

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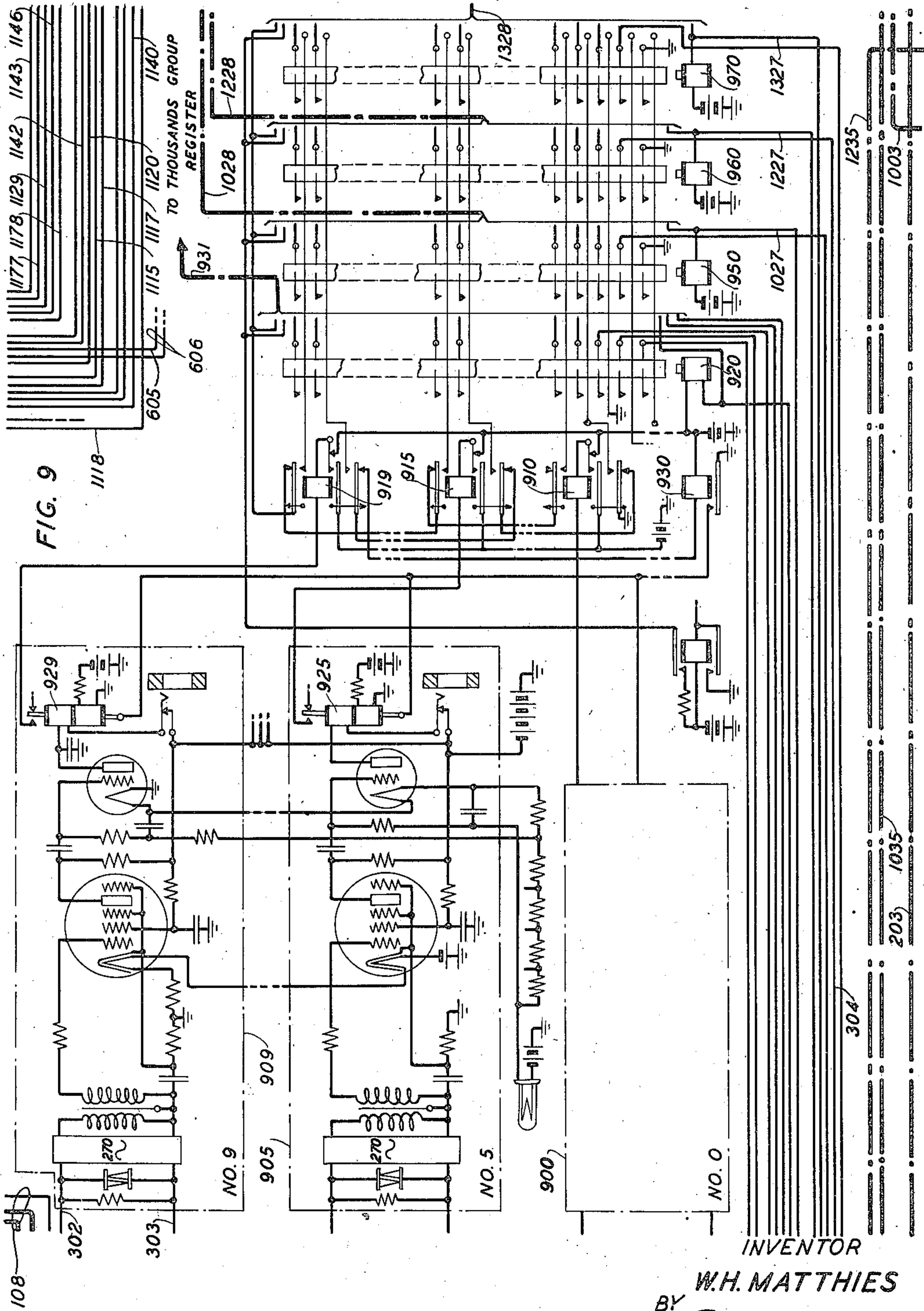
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15 Sheets-Sheet 9



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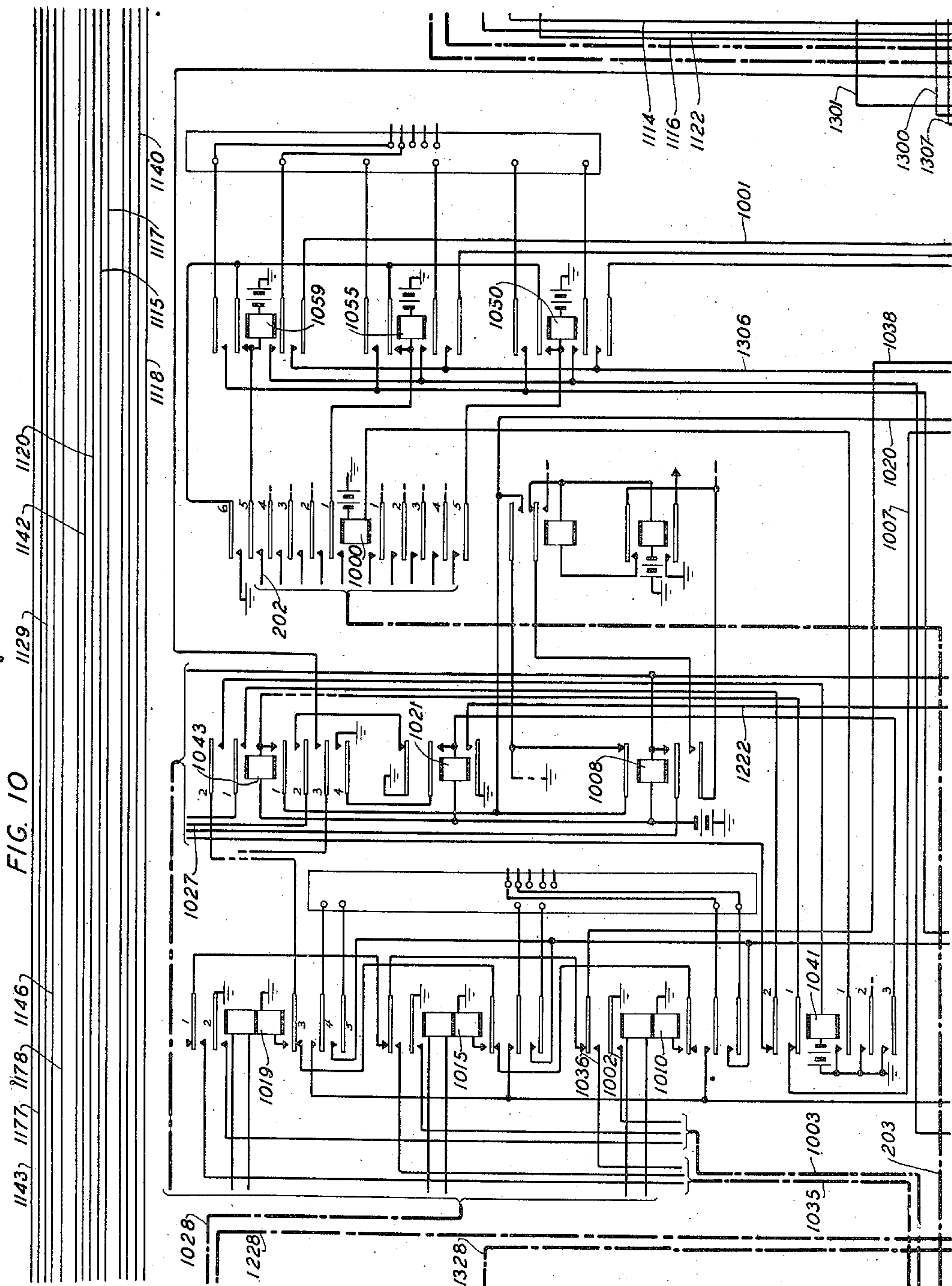
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15 Sheets-Sheet 10



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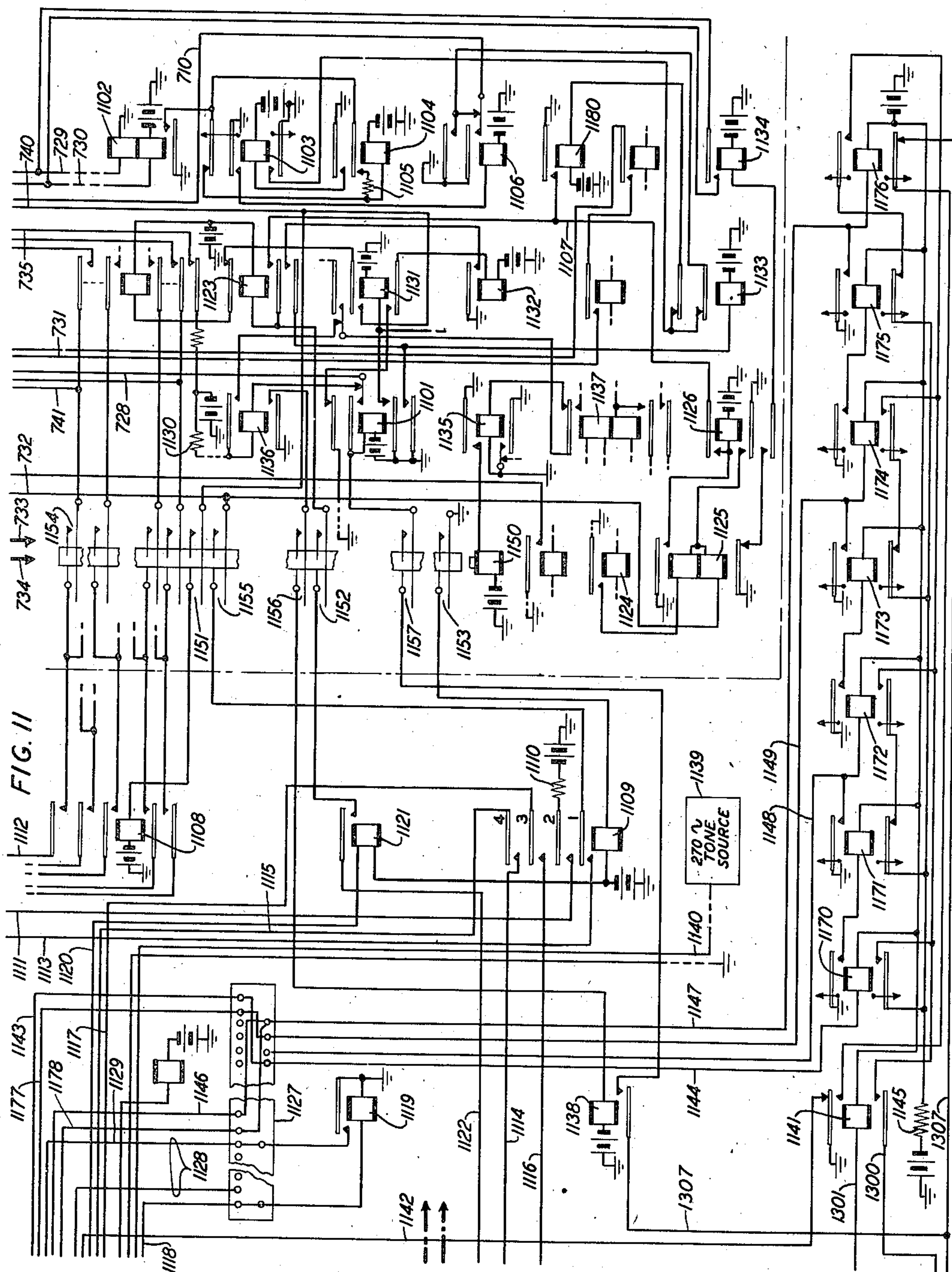
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15 Sheets-Sheet 11



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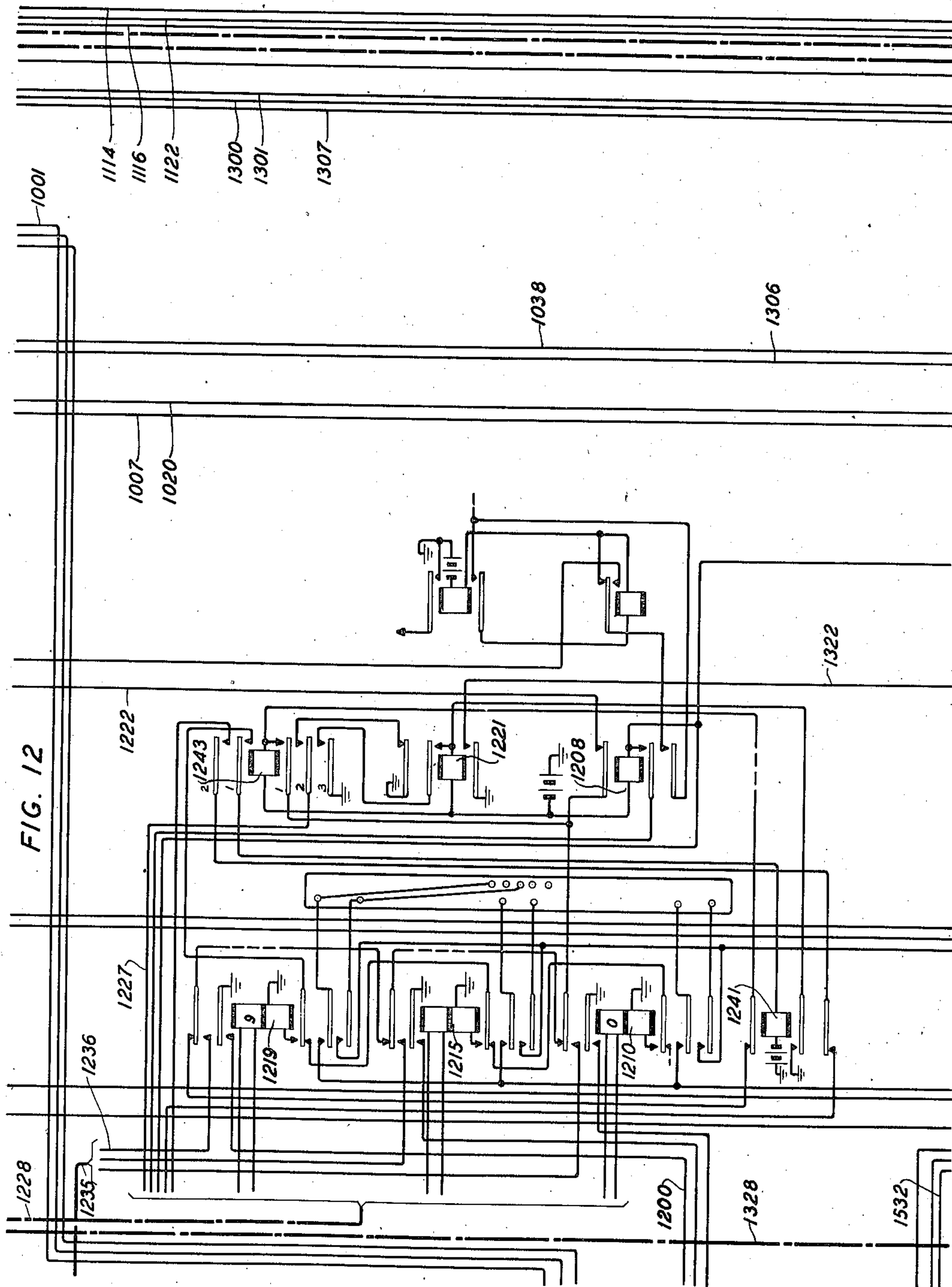
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15 Sheets-Sheet 12



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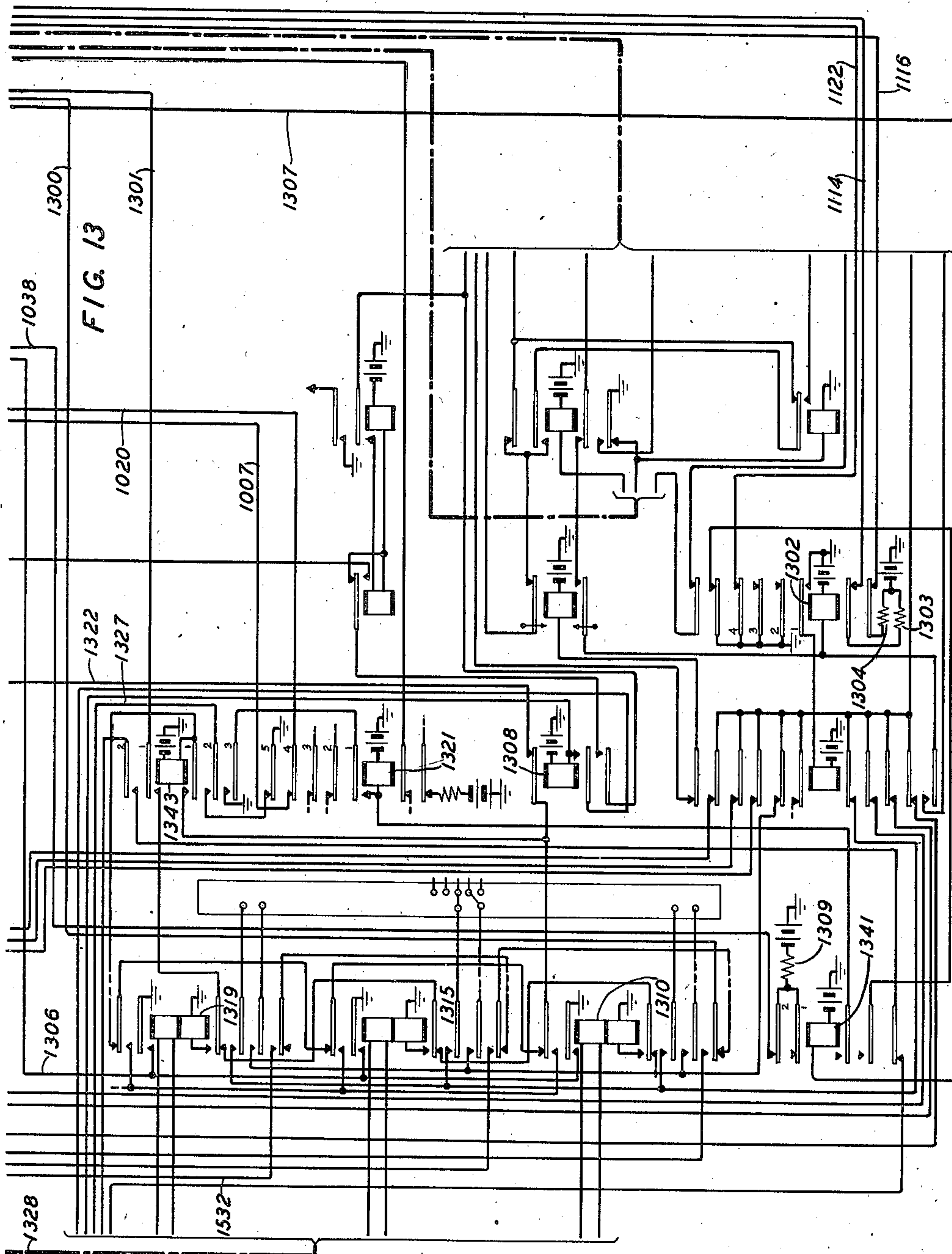
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15 Sheets-Sheet 13



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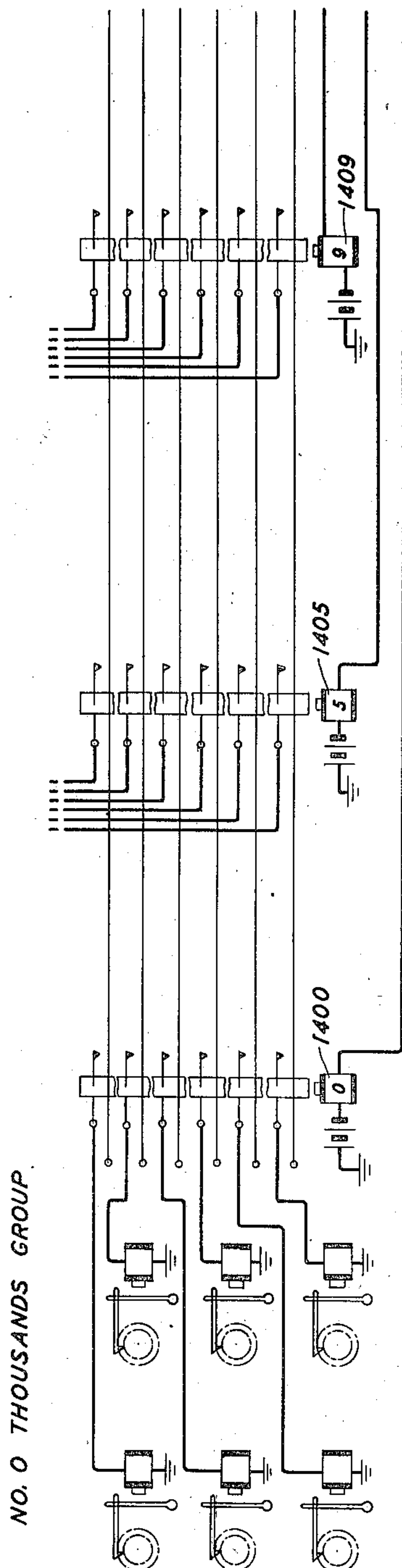
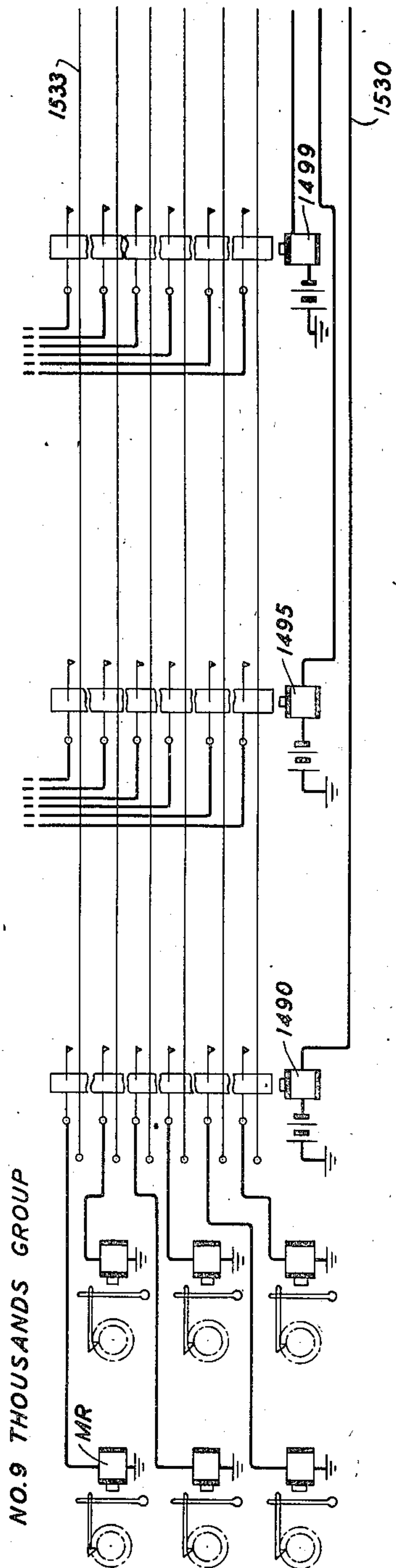
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15 Sheets-Sheet 14



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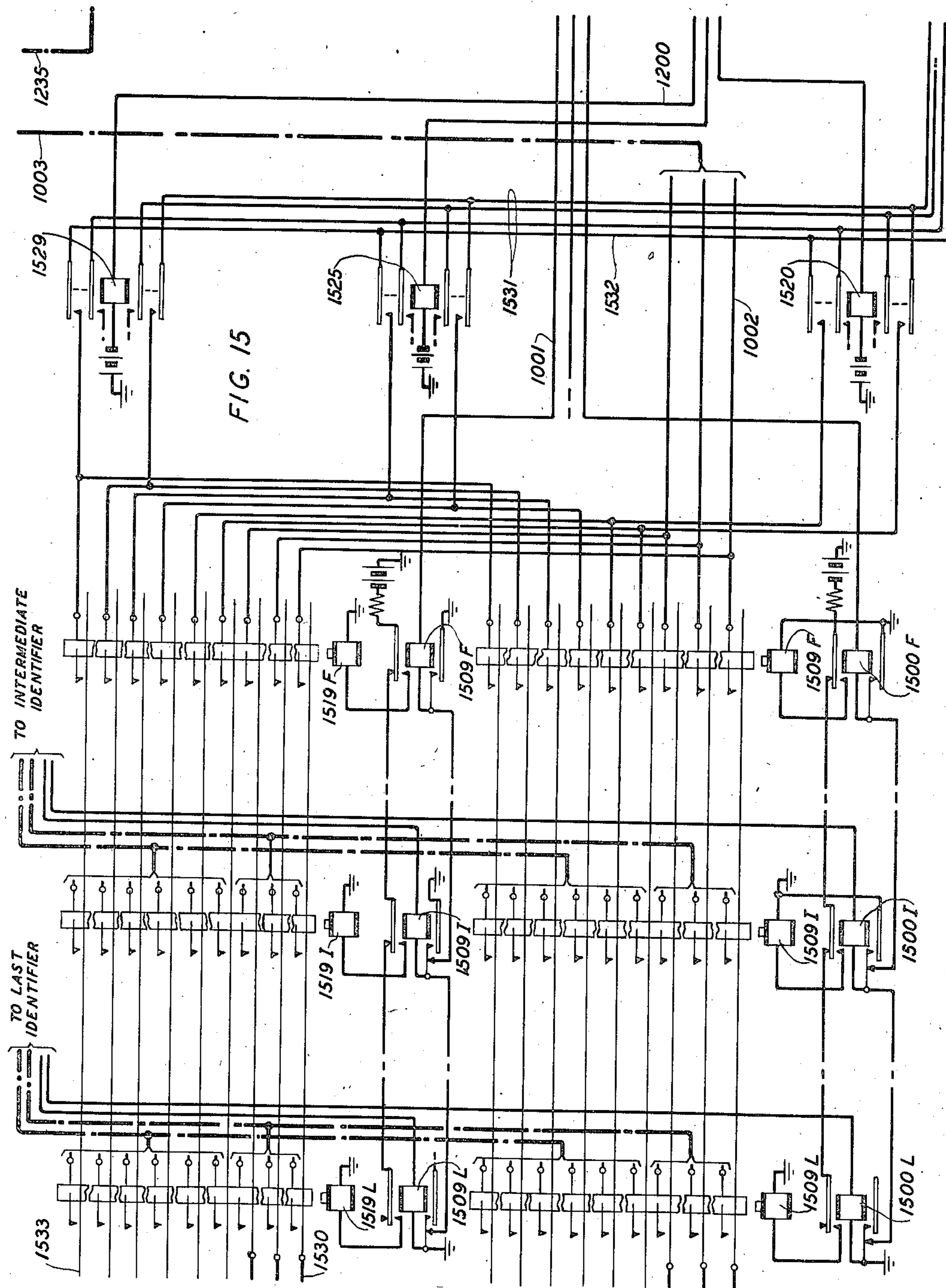
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15 Sheets-Sheet 15



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UNITED STATES PATENT OFFICE

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TIME CONTROLLED REGISTER FOR AUTOMATIC TELEPHONE SYSTEMS

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Application June 12, 1943, Serial No. 490,568

8 Claims. (Cl. 179—7.1)

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This invention relates to dial switching telephone systems and more particularly to telephone systems in which a charge is automatically made for each completed call.

In large exchange areas having several offices, some of which may be located at quite distant points in the area, it is desirable that means be provided whereby a calling subscriber may be charged differently for calls to offices which are most remotely located from the office in which the calling line terminates than for calls to offices which are not so remotely located since the remotely located offices must be reached over long interoffice trunks which are expensive to install and maintain and it is not equitable to the operating company to provide service to all points in the exchange area at the same basic rate. Furthermore it is not equitable to the operating company that for a basic charge, the subscriber shall be enabled to hold established connections indefinitely. Both automatic charging in accordance with the zone of the exchange area into which a connection is extended and in accordance with the elapsed conversational period have been heretofore accomplished and whereby the charges for overtime periods of conversation may be made in accordance with the zone into which the connection has been extended and on a different basis than the charges for the initial period of conversation.

It has hereinbefore been difficult to apply this method of charging to exchange systems employing dial switching apparatus of the step-by-step type since in such systems it is customary to connect the message register of each message rate subscriber's line in parallel with the line cut-off relay and to operate such message register to charge for an established connection by the application of a higher or booster potential to the sleeve conductor of the calling line to operate the message register following the response of the called subscriber. It thus becomes very difficult to operate the message register more than once for any call and therefore in offices of this type the repeated operation of a message register in accordance with the zone into which the established connection has been extended and in accordance with the number of unit periods of conversation, becomes a very difficult problem to solve.

With this problem in mind, it is the object of the present invention to provide a solution therefor which will enable zone and overtime call charging to be applied to existing office areas of the step-by-step type with a minimum alteration

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in the existing central office line and switching equipment. It is of course to be understood that the invention is equally applicable to other types of systems.

It has heretofore been proposed to equip office areas of the step-by-step type with equipment whereby subscribers may establish short haul or so-called AB toll calls by dialing, thereby eliminating the services of the toll operator on such calls. To accomplish this it has been proposed to provide facilities for automatically printing on a toll ticket all of the information which may be required for ticketing or billing such calls to calling subscribers, that is, the calling and called subscriber's line identifications, the time and date that the call was made, the elapsed time of the conversation and such other data as may be required. A system of this type is disclosed in the application of J. W. Gooderham, Serial No. 448,782, filed June 27, 1942.

In this system in response to the dialing of one or more of the office code digits or letters of a wanted line number, a toll ticketing trunk is seized whereupon an idle sender common to a plurality of ticketing trunks is associated with the trunk over a trunk finder. The seized sender then proceeds to associate itself over a sender-identifier-connector with an idle calling line identifier and the seized identifier then proceeds to associate itself directly with the seized trunk over an identifier-trunk-connector after which it proceeds to identify the calling line and to register the digits identifying the office and number of the calling line. The identifier with the assistance of apparatus in the trunk and dial responsive registers in the sender also proceeds to reconstruct the office code digits of the wanted line dialed by the calling subscriber and to register such office code digits. With the office code digits of the called line office thus registered, the identifier operates the proper one of a plurality of route relays, individualized to the offices of the toll area, for enabling the sender to control the completion of the connection to the wanted called office and to the wanted line therein. With the called office route relay operated, the identifier is also enabled to determine the rate to be charged for the initial period of conversation. Each ticketing trunk of this system is also provided with register switches which are advanced periodically following the response of the called subscriber and until the termination of the conversation to register the elapsed time of the conversation which elapsed time is printed on the toll ticket as one of the items from which

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the charge for the toll call may be determined.

From the foregoing brief description of the automatic ticketing system, it will be seen that the apparatus thereof affords a basis for enabling zone and overtime charging by message registers, that is the determination of the charge rate in accordance with the zone of the called line and the elapsed time of conversation. In accordance with the present invention, this automatic ticketing equipment has been so modified that it not only is available for performing its automatic ticketing functions on short haul toll calls, but is also available for handling calls from subscribers' lines having message registers and for charging for calls on a zone and overtime basis. On any zone call requiring the operation of calling line message registers, a trunk is seized and if the trunk has access to several offices in a plurality of zones, it causes the association of an idle sender therewith over a trunk finder whereupon a calling line identifier becomes connected with the sender and the trunk in the manner previously described. The identifier then proceeds to reconstruct the office code digits of the wanted line dialed by the calling subscriber and to operate a zone relay in the trunk corresponding to the zone called as determined from the called office code. The identifier is then dismissed without identifying the number of the calling line.

The message registers of the entire calling office are grouped to be selected by a register connector. The trunk is provided with a timing circuit which is started upon the response of the called subscriber and continues in operation until the conversation is terminated and during the initial and each overtime period of conversation causes the identifier to become associated with the trunk and to identify the calling line. In response to each identification of the calling line, the identifier controls the register connector to select the register of the calling line whereby the identifier operates such register in accordance with the zone, initial and overtime registrations in the trunk.

The invention having been described in a general manner, reference may now be had to the following detailed description thereof taken in connection with the accompanying drawing in which:

Fig. 1 shows schematically in the upper portion thereof, a line finder and selector switches over which lines of a calling office may establish connections to a charging trunk shown in Figs. 4 and 5; in the central portion thereof one of the ten thousands transformer coils and the associated hundreds transformer coils of the thousands number circuit serving the office in which the calling line terminates and common to a plurality of calling line identifiers; and in the lower portion thereof a group of hundreds connector relays having access to the corresponding hundreds groups of lines of one of the thousands groups;

Fig. 2 shows in the left portion thereof two of the ten groups of thousands connector relays of the thousands number circuit and in the right portion thereof two of the tens transformer coils for identifying the tens groups and tens digits of the calling line and the units identifying pads of one of the identifiers;

Fig. 3 shows switching relays of an identifier for successively rendering different portions of the circuits of Figs. 1 and 2 effective and also

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shows a box indicating the common number and class circuit;

Figs. 4 and 5, taken together, show a complete zone and overtime charging trunk including a digit register, zone register relays and an elapsed time measuring switch;

Fig. 6 shows one of the identifier-trunk-connectors for connecting an identifier seized by a sender with the trunk of a group of one hundred trunks which has been connected to the sender;

Fig. 7 shows a trunk finder individual to the sender of which portions are disclosed in the right portion of Fig. 11;

Fig. 8 shows a sender-trunk-connector for connecting any seized sender with the trunk which has seized the sender.

Figs. 9, 10, 12 and 13, the portion of Fig. 11 to the left of the dot-dash line, Fig. 3 and the right portion of Fig. 2 previously referred to, show in schematic form such portions of the apparatus of an identifier as are necessary to an understanding of the invention; Fig. 9 showing in the right portion thereof switching relays and in the left portion thereof amplifier and detector circuits connectable to the several portions of the identifier circuits through the operation of the switching relays of Fig. 2 for detecting the presence of signaling current on the connected sleeve conductor of any calling line and register relays associated with the detector circuit; Fig. 10 showing in the left portion thereof, the register circuit for registering the hundreds digit of the calling line number and in the right portion thereof register circuits for registering the thousands digit of the calling line; Fig. 12 showing register circuits for registering the tens digit of the calling line number; and Fig. 13 showing register circuits for registering the units digits of the calling line number;

Fig. 11 shows in the left portion thereof certain control relays of the identifier, in the central portion thereof a sender-identifier-connector for associating a sender seized by a trunk with an idle calling line identifier, in the right portion thereof such elements of a sender as are necessary to an understanding of the invention and in the lower portion thereof message register control relays of the identifier;

Figs. 14 and 15 show the message register connector circuit, Fig. 14 showing two groups of hundreds connector relays having access to corresponding hundreds groups of message registers allocated to the corresponding hundreds groups of lines; and Fig. 15 showing two of the tens groups of thousands connector relays; and

Fig. 1A is a chart showing how the several figures of the drawings should be arranged to disclose the complete invention.

The line finder 101 schematically illustrated in Fig. 1 is of the well-known step-by-step type having two brush sets one of which has access to an upper bank of terminals in which one hundred lines terminate and the other of which has access to a lower bank of terminals in which a second one hundred lines terminate. Each group of two hundred lines is accessible from a subgroup of line finders, an idle one of which is started upon the initiation of a call from any line of the group. The selector switches 102, 103 and 104 schematically disclosed in Fig. 1 are also of the well-known step-by-step type being directly operable in response to dial impulses to establish connections to charge trunks over which connections may be further extended to subscribers' lines terminating in other offices of the near-by area or

to establish connections to toll ticketing trunks over which connections may be further extended to subscribers' lines terminating in offices of the near-by toll area. The trunk finder 700 of Fig. 7 is of the double brush step-by-step type.

The thousands number circuit disclosed in part in Figs. 1 and 2 and the common number circuit indicated by the box 300 in Fig. 3 are identical with the similar circuits disclosed in full in the Gooderham application hereinbefore referred to. The sender, only a few relays of which are disclosed in the right portion of Fig. 11 is substantially identical with that disclosed in full in the Gooderham application except that two relays 1136 and 1101 have been added together with associated circuit connections for enabling the sender to function properly on calls requiring zone and overtime message register control. The digit register 400 of the charging trunk of Figs. 4 and 5 is of the rotary step-by-step type which is advanced step-by-step in response to the dialing of an impulse series by the stepping magnet 401 and is restored to normal by the operation of the release magnet 402. The off-normal contact set 500 of Fig. 5 is operated in response to the movement of the brush shaft of the register 400 one step off-normal. The elapsed time switch 550 of Fig. 5 is of the type whose brushes are advanced step-by-step in response to the energization and deenergization of the stepping magnet 551 and advanced to normal in a restoring movement under the control of the stepping magnet.

The sender-identifier-connector 1150 of the Fig. 11 is identical with that disclosed in full in the Gooderham application except that provision is made for the extension of two additional control conductors from the identifier to the sender for use in connection with the added relays 1136 and 1101 of the sender. The sender-trunk-connector of Fig. 8 is one of a plurality effective to associate a seized sender with a calling trunk on calls requiring the printing of a toll ticket. One of these circuits would be provided for each subgroup of ten trunks and one of these circuits is taken for use as determined by the operation of the trunk finder 700 in associating a sender with the calling trunk. These connector circuits are identical with the corresponding circuits of the Gooderham application. The identifier-trunk-connector of Fig. 6 is one of a plurality effective to associate a seized identifier with a calling trunk. One of these circuits would be provided for each subgroup of twenty trunks and one of these circuits is taken for use as determined by the operation of the trunk finder 700 in associating a sender with the calling trunk. These circuits are substantially identical with the corresponding circuits of the Gooderham application except that additional circuit paths are provided thereover for enabling the identifier to transmit zone registration information to and from the trunk with which the identifier is associated.

To enable a clearer understanding of the invention and the mode of its operation, the manner in which a call from the calling line 100 of Fig. 1 to a called line in another zone of the exchange area will now be described. It will be assumed that the subscriber whose substation is indicated at 100 desires to secure a connection with a subscriber's line whose directory number is assumed to be MAR-1345. When the subscriber removes his receiver from the switchhook, an idle line finder, for example line finder 101 is started in the well-known manner to hunt for the calling line and to connect it with the first selector switch

102 paired with such line finder, whereupon the calling subscriber receives the usual dial tone to indicate that he may then proceed to dial the digits of the directory number of the wanted line. It will be assumed that in response to the dialing of the first office code letter M, the second office code letter A and the third office code letter R, the first, second and third selector switches 102, 103 and 104 are operated and a connection is thereby established over the conductors 105, 106, and 107 of an idle trunk 108 to the trunk apparatus disclosed in Figs. 4 and 5.

Upon the seizure of the trunk a circuit is established from ground at the third selector switch 104 over sleeve conductor 107 through the lower winding of sleeve relay 408 of the trunk, over the upper normal contacts of test jack 409, through the winding of relay 410 to battery and in parallel with the winding of relay 410 over the armature and back contact thereof and through resistance 411 to battery. Relay 408 operates from the low resistance battery thus supplied; prepares a locking circuit over its upper winding and uppermost front contacts; short-circuits its lower winding and prepares a circuit over its lower front contact for a purpose to be later described. Relay 410 also operates and removes resistance 411 from the parallel connection with its winding.

As soon as the talking circuit is cut through over the brushes of the selector switches, a circuit is established from ground through the upper winding of line relay 412 over the lower No. 2 back contact of relay 413, the upper No. 2 normal contacts of relay 414, tip conductor 105 of the trunk, tip brushes of the selector switches 104, 103 and 102 and line finder 101 over the calling line loop through the substation 100, thence returning over the ring brushes of the line finder 101 and selector switches 102, 103 and 104, ring trunk conductor 106, the lower No. 2 normal contacts of relay 414, the upper No. 2 back contact of relay 413 through the lower winding of relay 412 to battery. Relay 412 thereupon operates closing over its front contact a circuit for slow-to-release relay 415 which may be traced from ground over the lower No. 1 back contact of relay 413, over the front contact of relay 412, through the winding of relay 415 to battery and ground. Relay 415 thereupon operates; establishes an obvious circuit for slow-to-release relay 416; prepares over its upper No. 1 contacts a circuit for the stepping magnet 401 of the digit register 400 and for the slow-to-release relay 417; connects ground from the lower No. 3 back contact of relay 418 over its upper No. 3 front contact and the upper No. 2 back contact of relay 419 to the trunk finder start conductor 420 which is common to ten trunks of the subgroup; establishes a connection from ground and battery through the winding of relay 419 over the upper No. 3 back contact of relay 418 and the No. 1 lower front contact of relay 415 to conductor 421 to mark the trunk as calling so that the started trunk finder will stop on the terminals of such trunk and over its lower front contact prepares a circuit for the transfer relay 413. Relay 416, upon operating, completes the locking circuit of sleeve relay 408 which may now be traced from battery through the upper winding and over the upper contacts of relay 408, over the upper normal contacts of jack 409, over the lower No. 2 back contact of relay 422 to ground on the lower front contact of relay 416 to hold relay 408 operated and over the sleeve conductor 107 of the trunk to hold the selector switches 102, 103 and 104 and the line finder 101 from releasing.

When relay 412 releases due to the opening of the dialing circuit for the first impulse of the thousands numerical digit 1 of the wanted line number, the circuit for magnet 401 and the circuit for relay 417 previously prepared by the operation of relay 415 are completed from ground over the lower No. 1 back contact of relay 413, over the back contact of relay 412, the upper No. 1 front contact of relay 412, conductor 423, the lower normal contacts of off-normal contact set 500 of the digit register 400, the lower normal contacts of relay 417 to battery through the winding of relay 417 and in parallel therewith to battery through the winding of stepping magnet 401. Magnet 401 and relay 417 both operate. Relay 417 because of its slow-to-release characteristic remains operated until the termination of the impulse series. Upon the first step advance of the register brush 424, the off-normal contact set 500 operates to its alternate position whereupon the operating circuit of relay 417 and magnet 401 are extended over the lower alternate contacts of relay 417 to ground over the circuit traced and over the contacts of relay 413. Since the thousands digit dialed was one, a single impulse is transmitted in the impulse series and brush 424 is therefore advanced to the first terminal position of its arc. Upon the termination of this impulse series, relay 417 releases.

In the meantime, however, the connection of ground to the trunk finder start conductor 420 has caused the operation of the group start relay 701L of Fig. 7, which is allocated to the first subgroup of ten trunks in the main group of one hundred trunks. Ten group relays are provided individual to the ten subgroups of trunks, the group relay of an intermediate group being shown at 701I and the group relay of the first group being shown at 701F. Group relay 701L, upon operating, connects ground over its inner lower contacts to the level segment 703 of the vertical commutator 702 of all trunk finders having access to the group of trunks; connects ground over its lower contacts to the trouble alarm circuit and causes the operation of the start relay 709 of the first idle trunk finder. The trunk finders are divided into preference subgroups in accordance with the subgroups of trunks whereby any trunk of a subgroup has the preferential use of trunk finders of a particular subgroup. If at any time all of the trunk finders which are the first choice preference of a subgroup of trunks are busy, such subgroup of trunks then has second choice use of the trunk finders of another subgroup which are normally the first choice of another subgroup of trunks.

The trunk finder 700 is the first finder of the last subgroup of finders allocated as first choice to the last subgroup of trunks to which the group relay 701L appertains. It will be assumed that this finder is idle and therefore upon the operation of relay 701L, a circuit is established from ground over the back contact of relay 705, the upper contacts of relay 701L, in-start conductor 706, over the middle normally closed contacts of the test and busy jack 707 of the trunk finder 700, over the inner upper normal contacts of relay 708, through the winding of start relay 709 to battery and ground. Relay 709, upon operating, connects ground over its upper front contact to conductor 710 and causes the operation of the stepping relay 711 in a circuit extending from ground over its lower contacts, interrupter contacts of vertical magnet 712, interrupter contacts of rotary magnet 713, lower winding of

relay 711 to battery and ground over the inner lower back contact of relay 708. Relay 711, upon operating, causes the operation of the vertical stepping magnet 712 over a circuit extending from ground over the lower contacts of relay 709, over the contacts of relay 711, the upper back contact of relay 714, through the winding of magnet 712 and to battery over the inner lower back contact of relay 708. The brush shaft of the finder is thereby lifted one step placing the commutator brush 715 on the first vertical segment of the vertical commutator 702. The vertical off-normal springs 716 are now operated to their alternate positions and the circuit of relay 711 is opened at the interrupter contacts of magnet 712. Relay 711 now releases in turn releasing magnet 712 which in turn recloses the circuit of relay 711. Relay 711 reoperates and causes the reoperation of magnet 712. In this manner, magnet 712 is repeatedly operated and released to advance the brush shaft upwardly step-by-step until the commutator brush 715 engages the grounded segment 703 whereupon a circuit is established from ground on such segment, over brush 715 through the lower winding of relay 714, over the interrupter contacts of rotary magnet 713, through the lower winding of relay 711 to battery and ground over the inner lower back contact of relay 708. Relay 711 is thus held operated to prevent further stepping and relay 714, which is slow to operate, operates after an interval sufficient to permit the switch brushes to cease vibrating following the completion of the last vertical stepping movement before they are started in their rotary stepping movement.

When relay 714 operates, it locks in a circuit from battery over the inner lower back contact of relay 708, through the winding of magnet 712, through the upper winding and over the inner upper front contact of relay 714 to ground over the lower contacts of relay 709; opens at its inner lower back contact the circuit extending over the lower contacts of off-normal springs 716, through the winding of release magnet 717; and transfers the stepping circuits control of stepping relay 711 from the vertical magnet 712 to the rotary magnet 713. With stepping relay 711 now operated, the circuit of the rotary magnet 713 may be traced from ground over the lower contacts of relay 709, contacts of relay 711, upper front contact of relay 714, through the winding of magnet 713 to battery and ground. Magnet 713 upon operating advances the brush sets of the finder one step in a rotary direction and opens at its interrupter contacts the holding circuit of relay 711 previously traced and the operating circuit thereof extending from ground over the lower contacts of relay 709, interrupter contacts of magnet 712, interrupter contacts of magnet 713 and the lower winding of relay 711 to battery over the inner lower back contact of relay 708 whereupon relay 711 releases in turn releasing magnet 713. Magnet 713 upon releasing reestablishes the circuit of relay 711 and relay 711, upon reoperating, reestablishes the circuit of magnet 713 to advance the brush sets another step in the rotary direction. In this manner the brush sets are advanced step-by-step until the test brush 718 encounters the test terminal 719 of the calling trunk.

It has been assumed that the calling trunk of Figs. 4 and 5 appears in the last terminal set of the level of the banks of the trunk finder corresponding to the commutator segment 703 which levels are partially shown and therefore when

the brush sets have been stepped vertically to a position opposite such levels in their banks as illustrated and have been advanced ten steps in a rotary direction into engagement with the last terminal sets of such levels, a circuit will be established from battery applied through the winding of relay 419 of the trunk over conductor 421 to the test terminal 719, thence over test brush 718 through the lower winding of relay 720, upper back contact of relay 708 and through the upper winding of relay 711 to ground on conductor 710. Relay 711 is held operated over this circuit to prevent further rotary stepping of the switch shaft and relay 720 operates sufficiently to close its inner upper contacts thereby establishing a circuit from battery through its upper winding over such contacts, the lower contacts of rotary magnet 713, contacts of relay 711 to ground over the lower contacts of relay 709. Both of its windings being now energized, relay 720 fully operates to extend control conductors 425 to 431, inclusive, of the trunk over brushes 721 to 727, inclusive, of the trunk finder and the upper Nos. 3, 4 and 6 and lower Nos. 1 to 4 contacts of relay 729 to conductors 728 to 734, inclusive, extending to the sender; to cause the operation of relay 708 in a circuit extending from ground over the off-normal springs 716, the lower No. 5 front contact of relay 720, through the lower winding of relay 708 to battery and ground; to connect sender conductor 735 over its upper No. 5 contacts and brush 736 to conductor 741 which is multiplied to corresponding bank terminals in the same vertical row of the upper finder bank; to open at its lower No. 5 back contact another point in the circuit of release magnet 717 and to prepare a locking circuit for itself over its upper No. 1 front contact which will be effective following the operation of relay 708.

Relay 708, upon operating, extends trunk conductor 421 over terminal 719 and brush 718, the upper No. 2 contacts of relay 720 and the upper front contact of relay 708 to conductor 710 extending to the sender; completes the locking circuit of relay 720 extending from battery through the upper winding and upper No. 1 contacts of relay 720, over the middle upper contacts of relay 708 to ground on conductor 710; transfers at its inner upper contacts the in-start conductor 706 from the winding of start relay 709 to the out-start conductor 742 and through its upper winding to battery at the upper back contact of relay 737; at its inner lower back contact removes battery from the windings of relays 711 and 714 and from the vertical magnet 712 and at its upper front contact shunts the upper winding of relay 711. Relays 711 and 714 now release and relay 709, being slow to release, releases after an interval sufficient to allow ground to be applied to conductor 710 at the sender to hold relay 720 and relay 419 of the trunk operated.

When relay 714 releases the continuity of the outstart conductor 742 is established at its lower contacts whereby if a second trunk in the same subgroup should be in a calling condition, ground placed on the in-start conductor 706 will be effective to start the second trunk finder of the same subgroup of finders if it is idle over a circuit extending from conductor 706, over the middle normal contacts of test jack 707, the inner front contacts of relay 708, the lower normal contacts of relay 714, conductor 742, the lower normal contacts of test jack 707, the middle normal contacts of test jack 707' associated with the second trunk finder of the same trunk finder

group, thence over the upper normal contacts of relay 708' to the start relay of such second finder corresponding to relay 709. Had such second finder of the subgroup of finders been busy and consequently relay 708' had been operated, the start circuit thus traced would be extended over the front contacts of this relay, the lower normal contacts of test jack 707', the middle normal contacts of test jack 707'', associated with the first finder of the next subgroup of finders, serving as second choice finders to the last subgroup of trunks and first choice to another subgroup of trunks, thence over the normal contacts of relay 708'', of such finder to the start relay thereof. In a similar manner the instart conductors 706, 738, 739, etc., of the ten trunk subgroups may be extended to start trunk finders in the allocated first choice subgroups of finders or in other choice subgroups of finders.

When the trunk finder seized the terminals of the calling trunk and completed the circuit previously traced from battery through the winding of relay 419, relay 419 operated and locked itself over its No. 1 upper front contacts directly to ground applied over conductor 421 from the trunk finder and at a later time from the sender. As soon as relay 417 releases following the completion of the registration of the impulse series in the digit register 400, a circuit is completed for transfer relay 413 which may be traced from battery through the winding of such relay, over the lower No. 2 contacts of relay 419, over the lower No. 2 front contact of relay 415 and the upper back contact of relay 417 to ground over the upper alternate contacts of off-normal contact set 500. Relay 413 thereupon operates and locks over its upper No. 1 contacts, conductor 432, the inner upper back contact of charge relay 501, conductor 433 to ground over the lower No. 1 contacts of relay 419 and to ground over the upper No. 1 contacts of relay 414 when relay 414 later operates. With relay 413 operated, the dialing circuit previously traced over the calling line loop and through the windings of relay 412 is disconnected from the windings of such relay and transferred to the connected sender. Relay 412 now releases followed by the release of slow-to-release relay 415, but with relay 419 now operated, relay 416 is held operated over a circuit extending from battery through its winding, over the upper No. 3 contacts of relay 419 to ground.

Should an idle sender not be connected to the trunk before the second train of impulses is received in the trunk, relays 413 and 419 will not have operated and therefore when relay 412 releases on the first impulse of this digit series, a circuit will be established from ground over the lower No. 1 back contact of relay 413, back contact of relay 412, the upper No. 1 contacts of relay 415, the lower alternate contacts of off-normal contact set 500, over the inner upper back contact of relay 417 to battery through the winding of relay 418. Relay 418 thereupon operates, locks over its upper No. 1 contacts to ground over the inner lower contacts of relay 416; establishes an operating circuit for the cut-through relay 414 extending from battery through the winding of such relay over the upper No. 2 contacts of relay 418 to ground at the inner lower contacts of relay 416, which relay locks over its lower No. 1 contacts to ground over inner lower contacts of relay 416; prepares a path busy tone circuit over its lower No. 1 contacts; removes starting ground at its lower No. 3 back contact from the trunk finder start conductor 420 and

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at its upper No. 3 back contact disconnects marking battery through the winding of relay 419 from conductor 421. With relay 414 operated, the windings of relay 412 are disconnected from the calling line loop and the loop is extended over the tip conductor 105, the upper No. 2 alternate contacts of relay 414, conductor 434, the upper left winding of repeating coil 502, the upper back contact of reversing relay 503 to ground through the lower winding of supervisory relay 504 and over the ring conductor 106, the lower No. 2 alternate contacts of relay 414, conductor 435, through the lower left winding of repeating coil 502 and over the lower back contact of relay 503 to battery through the upper winding of relay 504. Relay 504 operates and closes a circuit for holding relay 416 operated following the release of relays 412 and 415 which occurs upon the operation of relay 414, which circuit may be traced from battery through the winding of relay 416 over conductor 436, the contacts of relay 504 and conductor 437 to ground over the upper contacts of relay 416. Relay 504 is thus under the control of the calling subscriber to control the release of the trunk. The paths busy circuit is now completed from the source of tone current 438 over the lower No. 1 contacts of relay 418 over the tip trunk conductor 105 and the calling line loop returning over the ring trunk conductor 106 and thence as traced to battery through the upper winding of supervisory relay 504.

It will be assumed, however, that an idle sender is attached to the trunk prior to the receipt of the second impulse series in the trunk. Prior to the operation of transfer relay 413, the loop circuit is established from battery through the lower winding of dial impulse response relay 1102 of the sender, over conductor 730, the upper No. 3 contacts of relay 720 and brush 723 of trunk finder 700, conductor 427, the upper No. 3 normal contacts of transfer relay 413, over the lower No. 1 back contact of relay 439, the lower No. 2 back contact of relay 418, through resistance 440 over the lower No. 3 normal contacts of relay 413, conductor 426, brush 722 and the upper No. 4 contacts of relay 720 of the trunk finder 700, conductor 729 and thence to ground through the upper winding of relay 1102. Relay 1102 operates over this circuit and establishes a circuit from ground over its contacts, the back contact of relay 1103 and through the winding of relay 1104 to battery and relay 1104 thereupon operates and locks through resistance 1105 and over its front contact to ground at the front contact of relay 1102 and at its upper front contact closes an obvious circuit for slow-to-release relay 1103. Relay 1103, upon operating, establishes obvious circuits for off-normal relays 1106 and 1180, relay 1006 upon operating connecting ground to conductor 710 to replace the ground applied thereto by relay 709 which latter relay releases after the trunk finder has found the calling trunk. Relay 1180 upon operating connects ground to the off-normal ground conductor 1107.

After the operation of transfer relay 413, conductor 426 of the loop circuit previously traced through the windings of relay 1102 is connected over the lower No. 3 alternate contacts of relay 413 and the upper No. 2 normal contacts of relay 414 to the tip conductor 105 and conductor 427 is connected over the upper No. 3 alternate contacts of relay 413, over the lower No. 2 normal contacts of relay 414 to the ring conductor 106 whereby relay 1102 is placed under the control of the calling subscriber. In response to the dialing

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of the hundreds, tens and units digits of the wanted line number, dial impulse responsive relay 1102 now responds to cause the registration of the hundreds, tens and units digits 3, 4 and 5 in registers (not shown) of the sender in the manner fully described in the Gooderham application hereinbefore referred to. After the first digit has been received in the sender, an idle identifier such as is disclosed in part in Figs. 3, 9, 10, 12, 13, the right portion of Fig. 2 and the left portion of Fig. 11 is associated with the sender by a sender-identifier-connector 1150 and the identifier is associated with the trunk by a trunk-identifier-connector.

Upon its seizure, the identifier is informed that the calling trunk is located in a particular subgroup of twenty trunks by a circuit extending from ground placed on conductor 710 by the sender, over the upper middle contacts of relay 708, the upper No. 1 contacts of transfer relay 729, conductor 740, contacts 1151 of sender-identifier-connector relay 1150 to battery through the winding of relay 1108 in the identifier. Relay 1108 thereupon operates. Start relay 1109 of the identifier is also operated in a circuit established over contacts 1153 of the sender-identifier-connector relay 1150 and establishes a circuit from battery through resistance 1110 over its No. 2 contacts, conductor 1111, conductor 735, over the upper No. 5 contacts of relay 720 and brush 736 of trunk finder 700, conductor 741, contacts 1154 of sender-identifier-connector relay 1150, contacts of relay 1108, conductor 1112, through the winding of lock-out relay 600F, allocated to the first identifier and to the identifier-trunk-connector having access to the Nos. 0 and 9 subgroups of trunks, over the inner upper normal contacts of similar lock-out relays 600I and 600L allocated to other identifiers to ground. Relay 600F operates, locks over its upper inner alternate contacts to ground, establishes an operating circuit for the multicontact relay 601F from ground through the winding of such relay, over the inner lower front contact of relay 600F, through resistance 602 to battery, and establishes a circuit from battery through resistance 603 over its middle upper front contact, conductor 1113, over the No. 1 contacts of identifier start relay 1110, contacts 1155 of the sender-identifier-connector relay 1150, conductor 732, over the lower No. 2 contacts of relay 720 and brush 725 of the trunk finder 700, conductor 429 through the windings of polarized connector relay 422 of the trunk, through resistance 446 to ground over the lower No. 3 contacts of relay 419. Multicontact relay 601F of the identifier-trunk-connector and relay 422 of the trunk finder both operate. Relay 601F extends a plurality of control conductors from the calling trunk to the identifier.

Polarized relay 422 is energized in such a manner as to operate its upper contacts and establishes a circuit from battery through resistance 1303 over the inner lower back contact of relay 1302, conductor 1114, the No. 4 contacts of relay 1109, conductor 1115, the No. 22 contacts of identifier trunk connector relay 601F, conductor 604, the upper No. 2 contacts of relay 422, brush 424 of digit register 400, which it has been assumed was advanced to the No. 2 terminal of its arc, over a conductor of the group 442, the No. 11 contacts of relay 601F, conductor 605 of group 606, extending to ground through the winding of one of a group of trunk code relays (not shown) in the identifier, thereby operating one of such relays. The thousands digit dialed

by the calling subscriber is thus transferred from the register 400 of the trunk to the trunk register of the identifier. Relay 422 also establishes a circuit from battery through resistance 1304, over the lower back contact of relay 1302, conductor 1116, the No. 3 contacts of relay 1109, conductor 1117, the No. 23 contacts of relay 601F, conductor 607, the upper No. 3 contacts of relays 422 to the lower contact of the sleeve relay of each trunk appearance on the banks of the selectors in order that the identifier may reconstruct the digits which may have been dialed to reach the trunk.

In the present case it has been assumed that the subscriber dialed all three of the code digits or letters of the called line number to reach the trunk and that therefore sleeve relay 408 was operated indicative of the fact that the trunk was seized over a third selector bank appearance thereof. With relay 408 operated, the connection of battery over the upper No. 3 contacts of relay 422, completes a circuit over the lower contacts of relay 408, code conductor 443, cross-connected over the rack 608 to conductor 609, over the No. 59 contacts of relay 601F, conductor 1118, through the winding of route relay 1119 to ground. Route relay 1119, upon operating, causes the reconstruction of the called office code digits dialed by the calling subscriber and their registration in the associated sender to enable the sender to control the extension of the desired connection from the charging trunk to the office in which the wanted line terminates; causes the transfer of the thousands digit registered in the trunk register of the identifier to a register in the sender whereby the sender may have complete information concerning the numerical designation of the wanted line to enable it to complete the establishment of the connection to such wanted line and transmits such other information to the sender as may be required by the sender in handling the call, all in the manner fully described in the Gooderham application hereinbefore referred to.

In addition relay 422 of the trunk establishes a circuit from ground over its upper No. 1 contacts, conductor 610, over the No. 21 contacts of relay 601F, conductor 1120 through the winding of relay 1121 to battery and ground whereupon relay 1121 operates as an indication to the identifier that the trunk which has been seized is one of a group which does not serve automatic ticketing calls and that therefore no toll ticket is to be printed. Relay 1121, upon operating, establishes a circuit from ground over the upper No. 4 back contact of relay 1302, conductor 1122, contacts of relay 1121, contacts 1152 of the sender-identifier-connector relay 1150 to battery and ground through the winding of relay 1123 of the sender, which relay upon operating locks over its inner lower contacts to the off-normal ground conductor 1107 and informs the sender that no ticket is to be printed for the call which it has been selected to serve.

As soon as the sender has received all of the information required for controlling the establishment of the connection, a control circuit is established which may be traced in part over conductor 733, the lower No. 3 contacts of relay 720 and brush 726 of the trunk finder 700 and conductor 430 to the tip conductor 444 of the outgoing trunk and over conductor 734, the lower No. 4 contacts of relay 720 and brush 727 of the trunk finder 700 and conductor 431 to the ring conductor 445 of the outgoing trunk.

When the sender has completed the establishment of the connection, the end of pulsing relay 1124 of the sender operates in the manner fully described in the Gooderham application hereinbefore referred to and establishes a circuit that may be traced from ground over its contacts through both windings of relay 1125 in series, thence as traced over conductor 732, through the windings of relay 422 of the trunk and through resistances 446 and 447 to battery and ground. Relay 422 operates in this circuit in such a manner as to close its lower contacts but relay 1125 of the sender does not operate. Relay 422, upon operating, extends conductor 429 over its lower No. 1 contacts, through the winding of cut-through relay 414, over the circuit just traced through the windings of relay 1125 of the sender. Relay 1125 now operates but relay 414 does not operate and relay 1125 upon operating causes the operation of relay 1126 which locks over its upper contacts to ground on the off-normal ground conductor 1107 and closes a shunt around the upper winding of relay 1125. With the upper winding of relay 1125 shunted, cut-through relay 414 of the trunk now operates and locks over its inner lower No. 1 contacts to ground over the lower inner contacts of relay 416.

Relay 414, upon operating, cuts through the calling line to the windings of supervisory relay 504 over circuits previously traced whereupon relay 504 operates and establishes a previously traced holding circuit for relay 416. Relay 414 also establishes a circuit toward the called subscriber's line which may be traced in part from tip conductor 444 over the upper No. 3 contacts of relay 414, conductor 448, through the upper right winding of repeating coil 502, through the winding of called supervisory relay 505, conductor 506, the upper No. 4 back contact of relay 418, conductor 507, through the lower right winding of repeating coil 502, conductor 449 and the lower No. 3 contacts of relay 414 to ring conductor 445. Relay 505 being polarized does not operate until the called subscriber answers.

The identifier having operated the route relay 1119 in accordance with the reconstructed called office code digits the route relay in addition to performing the functions previously discussed also establishes a circuit from ground over its contacts strapped over terminals of connecting rack 1127 to a conductor of the group 1128 extending over contacts of the identifier trunk connector relay 601F to battery through windings of the zone register relays 513' to 513* of the trunk. It will be assumed that the wanted line terminates in the X zone of the exchange area and that therefore the operation of route relay 1119 establishes a connection from ground over its contacts, strapped over terminals of rack 1127 to conductor 1129 over the No. 3 contacts of relay 601F and conductor 611 through the winding of zone register relay 513* to battery and ground. Relay 513* thereupon operates and locks over its upper No. 1 contacts, over the contacts of relay 504 and conductor 437 to ground over the upper contacts of relay 416. Thus zone register relay 513* remains operated throughout the duration of the conversation and until the calling subscriber releases the connection.

The identifier having operated its no-ticketing relay 1121 as an indication that no ticket is required and having operated no-ticketing relay 1123 of the sender, proceeds to operate relay 1131 without awaiting to identify the calling line and relay 1131 upon operating opens the circuit of

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relay 1135 which releases in turn releasing the sender-identifier-connector relay 1150 to release the identifier which in turn releases the identifier-connector relay 601F to disassociate the identifier from the trunk.

When the called subscriber answers, the direction of current flowing through the winding of supervisory relay 505 is reversed whereupon it operates in turn establishing a circuit from battery through the winding of reversing relay 503 which in turn operates to reverse the connection of the windings of supervisory relay 504 to the calling line for supervisory purposes, and establishes a circuit which is effective upon the next operation of relay 508 when interrupter 509 closes its back contact. This circuit may be traced from ground over the lower contacts of relay 503, conductor 510, the upper No. 5 contacts of relay 508 to battery and ground through the winding of relay 511. Relay 511 thereupon operates and locks over its lower contacts to ground on conductor 510 and prepares a circuit for charge relay 501 which is closed from ground on conductor 510, over the upper No. 5 contacts of relay 512, which operates a suitable interval following the operation of relay 508 when the interrupter 509 makes its front contact, over the inner upper contacts of relay 511 and through the winding of relay 501 to battery and ground. Relay 501 thereupon operates and locks over its inner upper front contact and conductor 433 to ground over the upper No. 1 contacts of relay 414. It is to be noted in this connection that relays 508 and 512 serve as interrupter relays alternately operated under the control of interrupter 509, relay 508 being operable over the upper No. 6 back contact of relay 512 when relay 512 is unoperated and the interrupter closes its back contact and relay 512 being operable over the upper No. 6 back contact of relay 508. When relay 508 is unoperated and the interrupter closes its front contact. Relays 508 and 512 and interrupter 509 are common to a sub-group of ten trunks.

Relay 501 upon operating opens the holding circuit of transfer relay 413 and establishes a circuit for relay 514 extending from battery through the upper winding of such relay, over the upper No. 4 back contact of overtime relay 515, over the normal terminal of the arc engaged by brush 552 of the elapsed time switch 550 to ground over the lower No. 3 front contact of relay 501. Relay 514 upon operating establishes the circuit of magnet 551 extending over its lower No. 2 front contact and conductor 518 to ground over the upper No. 4 contacts of relay 419, closes a loop over its lower No. 4 contacts and conductors 516 and 517 across conductors 426 and 427 to hold the sender relay 1102 operated and establishes a circuit from ground over its lower No. 3 contacts, conductor 425, brush 721 and the upper No. 6 contacts of relay 720 of the trunk finder 700, conductor 728, over the inner upper normal contacts of relay 1101, through the winding of relay 1136 and through resistance 1130 to battery and ground. Relay 1136 thereupon operates and establishes a circuit from battery through resistance 1130 over its upper contacts, over the normal contacts of relay 1131 and the upper back contact of relay 1137 to ground through the winding of relay 1135 which upon operating causes the operation of sender-identifier-connector relay 1150 to associate an idle identifier with the sender. The identifier then proceeds to connect itself over the identifier-trunk-connector relay 601F with the calling

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trunk. Relay 1136 upon operating and with relay 1150 operated establishes a circuit from ground over its lower contacts and contacts 1156 of relay 1150 to battery through the winding of relay 1138 of the identifier.

It will be recalled that relay 422 of the trunk has been so operated as to close its lower contacts and in such operated position holds its upper contacts in their normal condition. Relay 422 is held in such position over a circuit extending from battery through resistances 447 and 446 over the lower No. 1 contacts and through the windings of relay 422 and the lower No. 1 front contact of relay 414 to ground over the inner lower contacts of relay 416. Consequently, no circuits are effective to cause the identifier to reconstruct the called office code or to operate the no-ticketing relay 1121 as previously described. Since the no-ticketing relay 1121 of the identifier is not operated, the identifier proceeds to identify the calling line in the manner fully described in the Gooderham application hereinbefore referred to. For this purpose signaling current from the 270 cycle source 1139 is applied over conductor 1140, the No. 25 contacts of identifier-trunk-connector relay 601F, conductor 453, over the lower No. 2 contacts of relay 422, over the upper normal contacts of test jack 409, the upper contacts of trunk sleeve relay 408, trunk sleeve conductor 107, thence over the sleeve circuit of the connection established from the calling line including the sleeve brush 109 of the line finder 101, sleeve conductor 110 of the calling line, conductor 111 through resistance 112 and condenser 113 to a terminal strip 114 in the cross-connecting rack 115.

The identifier seizes the common number circuit 300 and causes the operation of switching relays 320 and 920 to associate the amplifier-detector circuits 900 to 909, inclusive, with the thousands coils of the thousands number circuits appertaining to the calling office and with thousands group register relays (not shown) in the identifier. It will be assumed that the numerical or directory number of the calling line is 9099. The signaling current from the source 1139 will therefore flow through the lower primary winding of the No. 0 hundreds coil 0HT9 to ground through the lower primary winding of the No. 9 thousands coil 9THT and will be induced in the secondary winding of coil 9THT over the upper Nos. 1 and 2 back contacts of relay 116, conductors of cable 117, over contacts of a connector relay (not shown) of the common number circuit 300, conductors of cable 301, over contacts 19 and 20 of switching relay 320 and conductors 302 and 303 to the input of the amplifier-detector circuit 909. This detector circuit therefore responds to the signaling current and operates its anode relay 929 which in turn causes the operation of register relay 919 over a circuit which may be traced in part from ground, over the contacts of relay 930, the contacts of relay 929 through the winding and inner lower normal contacts of relay 919 and thence to battery, whereupon relay 919 operates and locks. With register relay 919 and switching relay 920 both operated, a circuit is established over cable 931 for operating a thousands group register relay (not shown) which in turn is effective to establish a circuit over a conductor of cable 200 through the winding of the lock-out relay 219F of the No. 9 thousands number circuit allocated to the first identifier, assumed to be seized for use, thence over the lower normal contacts of other

lock-out relays 219I and 219L allocated to other identifiers to ground, if no other identifier has at this time seized the same thousands number circuit and its lock-out relay is not therefore operated. Relay 219F, upon operating, locks to ground over its lower contacts and establishes an obvious circuit for the No. 9 thousands group connector relay 239F which thereupon operates.

With relay 239F operated, the ten pairs of conductors extending from the secondary windings of the hundreds transformer coils associated with the No. 9 thousands transformer coils are extended over cable 201 to contacts of the switching relay 350; conductors from the windings of one hundred hundreds group connector relays, some of which are disclosed in the lower portion of Fig. 1 and ten groups of ten conductors each are extended from the multiple contacts of the ten hundreds groups of hundreds connector relays are extended in preparation for the tens and units identification tests. In the meantime the common number circuit 300 has proceeded to determine the cause and to be registered in the identifier the class of the calling line. When it has determined the class of the calling line and the office unit and thousands group in which the calling line is located, its services are no longer required and it is dismissed.

The thousands group register of the identifier also opens the circuit of switching relays 320 and 920 which release. After a timing interval, a circuit is established for start relay 1043 of the hundreds group register circuit which may be traced in part from ground over the back contact of relay 1003, conductor 1020, the upper No. 4 back contact of relay 1321, conductor 1007, upper No. 1 back contact of relay 1041 through the winding of relay 1043 to battery. Relay 1043 thereupon operates and locks over its lower No. 1 contacts and the upper back contact of relay 1008 to its operating ground and establishes a circuit for the hundreds switching relays 350 and 950 which may be traced from battery through the windings of such relays in parallel, over conductor 1027 of cable 1023 and over the lower No. 2 contacts of relay 1043 to ground on the upper back contact of relay 1021. The secondary windings of all of the hundreds transformer coils 0HT9 to 9HT9 are now connected over contacts of thousands group connector relay 239F, conductors of cable 201, contacts of switching relay 350 to the input sides of the ten amplifier-detector circuits 900 to 999, inclusive. It being assumed that the calling line was located in the No. 0 hundreds group, the signaling current applied to the sleeve conductor of the calling line will be applied through the primary winding of the hundreds transformer coil 0HT9 to ground and will induce current into the secondary winding of such coil which is effective to energize the No. 0 amplifier-detector circuit 900 to thereby operate the anode relay thereof and the register relay 910. Relay 910, upon operating, with switching relay 950 operated, establishes a circuit over conductors of cable 1023 through the upper operating winding of hundreds group register relay 1010. Relay 1010, upon operating, locks in a circuit from ground through its lower winding and over its inner lower front contact, over the inner lower back contacts of the other register relays 1015, etc., over the upper No. 2 contacts of relay 1043 to battery through the winding of relay 1041.

Relay 1041, which operates in the locking cir-

cuit of relay 1010, establishes an obvious operating circuit for advance relay 1021 and at its upper No. 1 back contact opens the initial operating circuit of start relay 1043. Relay 1043, however, remains operated over its locking circuit. Relay 1021, upon operating, locks over its upper front contact and the lower No. 4 contacts of start relay 1043 and at its upper back contact opens the previously traced circuit of switching relays 350 and 950 which release in turn causing the release of register relay 910. After a timing interval, a circuit is effective for the start relay 1243 of the tens group register circuit of Fig. 12 which may be traced from battery through its winding over the upper back contact of relay 1241, over the upper back contacts of register relays 1210 to 1219, inclusive, the upper back contact of relay 1208, conductor 1222 to ground over the lower contacts of relay 1021. Relay 1243 operates and locks over its lower No. 1 contacts and the back contact of relay 1208 to ground on conductor 1222, prepares at its upper No. 1 contacts the locking circuit for the register relays 1210 to 1219 and establishes a circuit from ground over the upper back contact of relay 1221, the lower No. 2 contacts of relay 1243, conductor 1227 of cable 1228 to battery through the windings of switching relays 360 and 960.

With register relay 1010 of the hundreds group register circuit operated, a circuit is established for the No. 0 hundreds group connector relay 190 of the No. 9 thousands group which may be traced from ground through the winding of such relay over conductor 118, the No. 5 contacts of the thousands group connector relay 239F, conductor 1036 of cable 1035, the upper front contact of relay 1010, conductor 1038, over the upper No. 2 back contact of relay 1341 through resistance 1309 to battery and ground. Relay 190 operates over this circuit to connect the sleeve conductors of the 100 lines of the No. 0 hundreds group over its contacts and the contacts of the operated thousands group connector relay 239F to the tens and units identification circuits shown in the right portion of Fig. 2.

The hundreds connector relay 190, upon operating, establishes a circuit from ground over its lower contacts, conductor 119, the No. 15 contacts of the thousands connector relay 239F, conductor 204, the upper contacts of switching relay 360, conductor 304, the next to lower contacts of switching relay 960 to start the timing circuit associated with the amplifier-detector circuits, which upon starting opens the initial operating circuit of start relay 1243 of the tens group register circuit. Relay 1243, however, remains operated over its locking circuit.

Relay 1041, upon operating, also establishes a circuit from ground over its lower No. 1 contacts, through the winding of relay 1000 to battery and ground and relay 1000 operates and extends the conductors of cable 203 to the windings of the thousands group register relays 1050 to 1059. Since as assumed the calling line was found, upon the thousands group test, to be located in the No. 9 thousands group and the No. 9 thousands group connector relay 239F was operated, a circuit is now effective from ground over the No. 3 contacts of relay 239F, conductor 202 of cable 203, the upper No. 5 contacts of relay 1000 to battery through the winding of register relay 1059. Relay 1059 thereupon operates and locks over its inner upper contacts to ground over the upper No. 6 contacts of relay 1000.

As previously stated, when the hundreds group

connector relay 190 operates, and with the thousands group connector relay 239 operated, the sleeve conductors of one hundred lines are extended over contacts thereof, over conductors of cable 205 to the tens group and terminal identifying circuits of Fig. 2. The one hundred conductors thus extended from the hundred sleeve conductors are grouped in ten groups of ten conductors each, corresponding to the tens of hundreds groups which have the same tens identification digits. Each conductor terminates in a serially connected condenser and resistance and each group of ten conductors is multiplied to one terminal of the primary winding of a tens group transformer coil such as 259, the other terminal of which is connected to ground. The secondary windings of the transformer coils 250 to 259, inclusive, are connected over conductors of cable 203 and contacts of switching relay 360 to the input sides of the amplifier-detector circuits 900 to 909 of Fig. 9.

It has been assumed that the tens digit of the calling line identification is 9 and that the units digit is 9 and that therefore the signaling current on the sleeve conductor of such line is conducted over contacts of relays 190 and 239F and conductor 207 of cable 205, condenser 208, resistance 209 and the primary winding of the No. 9 transformer coil 259 to ground. The signal current is thereupon induced into the secondary winding of coil 259 and is applied over conductors of cable 206 and contact switching relay 360 to the No. 9 amplifier-detector circuit 909 to operate the anode relay 929 thereof. Relay 929 thereupon operates in turn operating register relay 919 which with switching relay 960 operated, establishes an operating circuit over the contacts of relay 919, contacts of relay 960 and conductors of cable 1228 to the operating winding of the tens group register relay 1219. Relay 1219 thereupon operates and locks in a circuit from ground through its lower front winding and over its inner lower contact, over the upper No. 1 contacts of relay 1243 to battery through the winding of relay 1241. Relay 1241, upon operating in the locking circuit of register relay 1219, establishes an obvious circuit for advance relay 1221 and opens the initial operating circuit of start relay 1243, which later relay, however, remains operated over its locking circuit. Relay 1221 upon operating locks over its upper front contact and the lower No. 3 contacts of relay 1243 and at its upper back contact opens the previously traced circuit for switching relays 360 and 960 which release in turn releasing the associated timing circuit. The timing circuit establishes the circuit for start relay 1343 of the units register circuit of Fig. 13 which may be traced in part from battery through its winding over the upper back contacts of register relays 1310 to 1319, inclusive, over the back contact of relay 1308 and conductor 1322 to ground over the inner lower contacts of advance relay 1221. Relay 1343 operates and locks over its lower No. 1 contacts and the back contact of relay 1308 to ground over conductor 1322, prepares at its lower No. 3 contacts a locking circuit for relay 1321, prepares at its upper No. 1 contacts a locking circuit for register relays 1310 to 1319 and establishes a circuit from ground over the upper back contact of relay 1321, the lower No. 2 contacts of relay 1343 and conductor 1327 of cable 1328 to battery through the windings of switching relays 370 and 970.

With relay 1219 of the tens group register circuit operated, a circuit is established for the No.

9 tens group connector relay 249 which may be traced from battery through its winding over conductor 1236 of cable 1235, over the upper front contact of register relay 1219, over the upper back contacts of other relays of the register group, over the upper back contact of relay 1208 to ground on conductor 1222. Relay 249, upon operating, connects each of the group of tens conductors of cable 205 connected over the contacts of connector relays 239F and 190 to the sleeve conductors of the ten lines having the same tens digits to ground through a condenser-resistance network. It has been assumed that the calling line has a units digit 9 and that therefore with the signal current applied to the sleeve conductor 110, the current is transmitted over contacts of relays 190 and 239F, conductor 207 of cable 205, over the upper No. 6 contacts of relay 249 to ground through condenser 269 and resistance 279 of the network and through resistance 289 and over conductors of cable 280 and contacts of switching relay 370 to the input side of amplifier-detector circuit 909. In response to the signal current, anode relay 929 is operated thereby causing the operation of register relay 919.

With register relay 919 operated, a circuit is established over the contacts of switching relay 970 and conductors of cable 1328 through the upper winding of units register relay 1319. Relay 1319 thereupon operates and locks in a circuit from ground through its lower winding and inner lower front contact, over the upper No. 1 contacts of relay 1343 and conductor 1301 to battery through the winding of relay 1141. Relay 1141 operates in this locking circuit and at its lower contacts prepares the circuit of relay 1341. The digits of the calling line number have now been registered through the operation of register relays 1059, 1010, 1219 and 1319.

When a units register relay operated at which time the directory number of the calling line is completely registered, a circuit is established to start the selection of the message register allocated to the calling line. It has been assumed that the register relay 1319 has been operated to register the units digit of the calling line number and that register relay 1059 has been operated to register the thousands digit 9 of the calling line number. A circuit is therefore established from ground over the upper inner contacts of relay 1319, conductor 1306, the lower contacts of relay 1059, conductor 1001, through the winding of lock-out relay 1509F, allocated to the first identifier assumed to be in use for the connection, over the lower normal contacts of relay 1509I allocated to an intermediate identifier and to ground over the lower normal contacts of relay 1509L allocated to the last identifier, if at the time no other identifier is attempting to establish a connection to a message register in the same thousands group. Relay 1509F thereupon operates and locks directly to ground over its lower contacts and over its upper contacts establishes an obvious circuit for thousands connector relay 1519F.

Connector relays 1519F, 1519I and 1519L constitute the No. 9 thousands group of connector relays allocated, respectively, to different identifiers. The lock-out relays 1500F, 1500I and 1500L and the connector relays 1510F, 1510I and 1510L shown in the lower portion of Fig. 15 are allocated to the No. 0 thousands group of message registers and connector relay 1510F would have been operated through the operation of lock-out relay 1500F had the thousands group register relay 1050 been

operated to register the thousands digit 0. The other intermediate groups of lock-out relays and connector relays allocated to the other thousands groups of message registers would be similar to the groups disclosed.

It will be recalled that the hundreds group register relay 1010 was operated to register the hundreds digit 0 of the calling line number. With this relay operated and the thousands connector relay 1519F of the message register connector operated, a circuit is now effective for operating the No. 0 hundreds connector relay 1490 of the thousands group of such relays. The circuit of relay 1490 may be traced from ground over the inner upper contacts of register relay 1010, over conductor 1002 of cable 1003, over the lower contacts of thousands connector relay 1519F and conductor 1530 through the winding of connector relay 1490 to battery and ground. Relay 1490, upon operating, extends circuits from all message registers of the No. 0 hundreds group of the No. 9 thousands group over contacts of the operated thousands connector relay 1519F. These circuits are extended in ten groups of tens circuits each over the contacts of the operated thousands group connector relay to the contacts of ten tens connector relays 1520 to 1529, inclusive. With the tens group register relay 1219 operated to register the tens digit 9 of the calling line number, a circuit is established from ground over the inner upper contacts of relay 1219, conductor 1200 to battery through the winding of the tens group relay 1529 of the group of connector relays 1520 to 1529 individual to the identifier taken for use. Relay 1529 thereupon operates and extends the No. 9 tens group of message register operating circuits to the group 1531 of ten conductors extending to the contacts of the units register relays. It has been assumed that the units register relay 1319 has been operated to register the units digit 9 of the calling line number and therefore the circuit of the message register MR individual to the calling line whose directory number is 9099 is extended from ground through the winding of such register over the upper contacts of hundreds connector relay 1490, conductor 1533, over the upper contacts of thousands connector relay 1519F, the upper contacts of tens connector relay 1529, conductor 1532, over the lower front contact of units register relay 1519, over the lower back contacts of the other units register relays 1315—1310, conductor 1300, to the lower armature contact of message register control relay 1141.

Charges for calls to different charge zones of the exchange area might for example be made on the basis set forth in the following table:

Trunk Zone Relays Operated	Initial Period Charges Made	Initial Period Duration Measured	Overtime Period Charges Made	Overtime Period Duration Measured
513 ¹ -----	1	5	1	4
513 ² -----	2	5	1	3
513 ³ -----	3	5	2	2
513 ⁴ -----	4	5	2	1

It will be recalled that zone charge relay 513^x has been operated in the trunk and that the elapse time switch is still in its normal position in which it has caused the operation of charge relay 514 and the energization of stepping magnet 551. With zone relay 513^x operated and prior to the operation of relay 1141, a circuit is established from ground over the upper back contact of relay 1141, conductor 1142, the No. 10 con-

tacts of identifier trunk connector relay 601F, conductor 520, the lower No. 1 contacts of relay 501, the lower back contact of relay 515, the lower No. 2 contacts of relay 513^x, conductor 521, the No. 1 contacts of relay 601F, conductor 1143 strapped across the connecting rack 1127 to conductor 1144 and through the winding of slow-to-release relay 1170 to battery. Relay 1170 upon operating establishes the circuit of slow-to-release relay 1171 which in turn establishes the circuit of slow-to-release relay 1172. In a similar manner relays 1173, 1174, 1175 and 1176 successively operate.

When relay 1141 operates and with relay 1170 operated, the message register operating circuit previously traced to the lower armature contact of relay 1141 is extended over the lower contacts of such relay and the lower contacts of relay 1170, through resistance 1145 to battery for energizing the message register MR to make one charge. Relay 1141 upon operating also opens at its upper back contact, the previously traced operating circuit for relay 1170 which releases after an interval determined by its slow-to-release characteristic, to open the circuit of the message register MR and to open the circuit of slow-to-release relay 1171. After an interval, relay 1171 releases thereby reconnecting battery through resistance 1145 over its lower back contact, the lower front contact of relay 1172, and the lower contacts of relay 1141 to the circuit of message register circuit MR thereby again operating such register to make a second charge. Relay 1171 upon releasing also opens the circuit of relay 1172 which releases after an interval again opening the circuit of the message register at its lower contacts. Relay 1172 upon releasing also opens the circuit of relay 1173. When relay 1173 releases after an interval, it reconnects battery through resistance 1145 over the back contact of relay 1173, the lower front contact of relay 1174 and over the lower contacts of relay 1141 to the circuit of message register MR thereby again operating such register to make a third charge. Relay 1173 upon releasing also opens the circuit of relay 1174 which releases after an interval again opening the circuit of the message register at its lower contacts. Relay 1174 releases after an interval opening the circuit of relay 1175 which also releases after a further interval and reconnects battery through resistance 1145 over its back contact, the upper contacts of relay 1176 and the lower contacts of relay 1141 to the circuit of the message register MR thereby operating such register to make a fourth charge. Relay 1175 upon releasing also releases relay 1176 which again opens the circuit of the message register. The message register MR has thus been operated four times to charge for the initial five-minute period of conversation.

Had the call been to a zone of the exchange area requiring but a single charge for the initial period, then the circuit previously traced from ground over the back contact of relay 1141 and thence over the lower back contact of relay 515 would have been extended over the inner lower contacts of zone register relay 513¹ assumed to be operated on such a call, over conductor 522, the No. 7 contacts of relays 601F, conductor 1146, strapped across rack 1127 to conductor 1147 and to battery through the winding of relay 1176. Therefore when relay 1141 operates as previously described, it opens the circuit of relay 1176, and battery through resistance 1145, over the back contact of relay 1175, the upper contacts of relay

1176 and the lower contacts of relay 1141 is applied to the circuit of message register MR to operate such register once during the releasing time of relay 1176. Had circuits been established through the operation of other zone register relays 513² or 513³ (not shown) of the trunk over either conductor 1148 or 1149, either relay 1172 or relay 1174 of the train of charging relays would have been first operated resulting in the operation of the message register MR to make two or three charges for the initial period of conversation.

When relay 1176 closes its back contact, it establishes the circuit of relay 1341 which may be traced from battery through its winding, over conductor 1307, over the lower back contact of relay 1176 and to ground over the upper front contact of relay 1141. Relay 1341 upon operating opens the circuit over which the hundreds connector relay 190 was operated whereupon such relay releases and also causes the release of relay 219F which in turn releases the thousands connector relay 239F. With relays 190 and 239F released, the thousands number circuit is now restored to its normal position. Relay 1176 also closes a circuit from ground over the upper front contact of relay 1141, over its lower back contact, the contacts of relay 1133, contact 1157 of the sender-identifier-connector relay 1150 to battery through the winding of release relay 1101 of the sender, whereupon relay 1101 operates, locks over its upper alternate contacts, conductor 728, the upper No. 6 contacts of relay 720 and brush 721 of trunk finder 700, conductor 425 to ground over the lower No. 3 contacts of relay 514, closes the circuit of relay 1131 which upon operating opens the circuit of relay 1150 to initiate the release of the identifier and closes at its lower contacts the circuit of release relay 1133 of the sender to initiate the release of the sender. The identifier-trunk-connector and trunk finder are now both released.

When the sender releases ground is removed from conductor 710 thereby releasing relay 720 of the trunk finder and relay 419 of the trunk. With relay 720 released, a circuit is established for release magnet 717 extending from battery through the winding of such magnet, over the lower contacts of off-normal switch 716, over the inner lower back contact of relay 714, the lower No. 5 back contact of relay 720, the upper back contact of relay 709 to ground over the upper contacts of off-normal switch 716. When the trunk finder is fully restored to normal, the contacts of switch 716 open thereby releasing the magnet 717.

At the trunk when relay 419 releases it opens the previously traced circuit of stepping magnet 551 of switch 550 and magnet 551 releases to advance the brushes one step from normal. When brush 552 leaves the normal terminal of its arc relay 514 releases. A circuit is now effective for further advancing the brushes of switch 550 step by step at fifteen-second intervals which may be traced from ground over the lower No. 3 front contact of relay 501, contacts of interrupter 519, brush 553, strapped terminals of the arc associated with brush 553, the lower No. 2 back contact of relay 514 through the winding of stepping magnet 551 to battery. It will be assumed that the conversation continues for eight minutes and that the initial period of conversation is fixed by the operating company as five minutes. At the expiration of five minutes, brush 552 of the switch will have been advanced into engagement with

the last terminal of its arc, thereby completing a circuit from ground over the lower No. 3 front contact of relay 501, brush 552, such arc terminal and then through the lower winding of relay 514 to battery and ground. Relay 514 thereupon operates extending its operating ground over its lower No. 1 contacts and through the lower winding of overtime relay 515 to battery and ground. Relay 515 now operates and locks itself over its upper winding and upper No. 1 contacts in a circuit extending over conductor 437 to ground over the upper contacts of relay 416.

Relay 514 upon operating closes a circuit for the line-finder group start relay 701L which may be traced through the winding of such relay over conductor 420, the upper No. 2 back contact of relay 419, conductor 450, over the upper No. 2 contacts of relay 514, conductor 451 to ground over the lower No. 3 back contact of relay 418. In the manner previously described the trunk finder individual to an idle sender is started to hunt for and connect with the calling trunk. It will be assumed that the trunk finder 700 is started. Relay 514 also marks the trunk as calling by connecting battery through the winding of relay 419 over the upper No. 3 back contact of relay 418, conductor 452 and the upper No. 1 contacts of relay 514, to conductor 421 terminating in bank terminal 719 of the trunk finder 700. When the brush 718 of the trunk finder engages terminal 719, the hunting movement of the finder is arrested and relay 419 is energized and locks directly to ground on conductor 421 in a manner previously described. Relay 720 of the trunk finder is also operated to extend control conductors from the trunk to the sender.

A circuit is thereupon established for relay 1102 of the sender which may be traced from battery through the lower winding of relay 1102, over conductor 730, the upper No. 3 contacts of relay 720 and brush 723 of the finder 700, conductors 427 and 517, over the lower No. 4 contacts of relay 514, conductors 516 and 426, over brush 722 and the upper No. 4 contacts of relay 720 of the finder 700, conductor 729 and to ground through the upper winding of relay 1102. Relay 1102 thereupon operates followed by the operation of relays 1103, 1104, 1106 and 1180. Relay 1103 upon operating applies ground to conductor 710 to hold relay 720 in the finder and relay 419 of the trunk operated. Relay 514 also closes the previously traced circuit for relay 1136 of the sender which upon operating establishes a circuit from battery through resistance 1130, over its upper contacts, over the normal contacts of relay 1131 and the upper back contact of relay 1137 to ground through the winding of relay 1135 which upon operating causes the operation of sender-identifier-connector relay 1150 to associate an idle identifier with the trunk. The identifier then proceeds to connect itself over the identifier-trunk-connector 601F with the calling trunk. Relay 1136 upon operating and with relay 1150 operated establishes the previously traced circuit for relay 1138 of the identifier.

The identifier now proceeds to identify the calling line and to select the message register of such calling line in the manner previously described. At the trunk, brushes 552 and 553 of the elapsed time switch 550 have been arrested in their advance through the operation of relay 514 and with overtime relay 515 and the zone relay 513² both operated, the identifier is now controlled to operate the message register MR of the identified calling line for the first overtime pe-

riod of conversation. By referring to the preceding table it will be noted that for a call into the No. X zone of the exchange area with zone relay 513* operated, two charges should be made for each one-minute overtime period of conversation. To accomplish this the upper Nos. 2, 3 and 4 contacts of zone relay 513* are strapped to the three terminals 523, 524 and 525 and the lower No. 1 contacts are connected over conductor 526, the No. 2 contacts of identifier trunk connector relay 601F and conductor 1177 strapped across the terminals of cross-connecting rack 1127 to conductor 1149. Thus prior to the operation of relay 1141 in the identifier ground applied over its upper back contact and conductor 1142 and thence as traced to the lower armature of relay 515 of the trunk, completes a circuit over the lower front contact of relay 515, the lower No. 1 contacts of relay 513*, thence as just traced to conductor 1149 and thence through the winding of relay 1174 to battery. Relays 1174 to 1176, inclusive, thereupon operate in succession. When thereafter relay 1141 operates, following the completion of the identification of the calling line and the selection of the message register MR of such line, relays 1174 to 1176, inclusive, successively release and in the manner previously described cause two operations of the message register MR to make two charges for the first overtime period.

Upon the completion of these charging operations, relay 1101 of the sender is operated thus causing the release of the identifier, the disassociation of the identifier from the calling trunk and the release of the sender. When the sender releases the trunk finder 700 releases and, ground being removed from conductor 710, relay 419 of the trunk releases in turn releasing stepping magnet 551 of the elapsed time switch 550 to advance the brushes 552 and 553 into engagement with the No. 1 terminals of their arcs. Since it has been assumed that the conversation is still continuing and relay 501 is therefore still operated, a circuit is now established from ground over the lower front contact of relay 501, brush 552 and the normal terminal of its arc, the upper No. 4 front contact of relay 515, the interrupter contacts of magnet 551, brush 553 and the normal terminal of its arc and the upper No. 2 contacts of relay 515 to battery through the winding of magnet 551, whereupon the brushes 552 and 553 are quickly advanced to the No. 2 terminals of their arcs. A circuit is now established from ground over the lower front contact of relay 501, brush 552 and the No. 2 terminal of its arc, over the upper No. 3 contacts of relay 515, the interrupter contacts of magnet 551, brush 553 and the No. 2 contacts of its arc and the lower No. 2 back contact of relay 514 to battery through the winding of magnet 551, relay 514 having released as soon as brush 552 left the last terminal of its arc. Magnet 551 upon operating and opening its own operating circuit quickly advances brushes 552 and 553 into engagement with the No. 3 terminals of their arcs. A circuit is now established from ground over the lower front contact of relay 501, through the contacts of interrupter 519, brush 553, the strapped terminals of its arc, over the lower No. 2 back contact of relay 514 to battery through the winding of magnet 551, whereupon magnet 551 advances the brushes 552 and 553 step by step at fifteen-second intervals under the control of interrupter 519.

When brushes 552 and 553 have thus been advanced four steps to measure a one-minute over-

time period of conversation, brush 552 will engage the seventh terminal of its arc, whereupon a circuit will be established from ground over the lower front contact of relay 501, brush 552 and the strapped Nos. 7, 8, 9 and 10 terminals of its arc, over the upper No. 4 contacts of operated zone relay 513*, the upper No. 4 front contact of relay 515, through the interrupter contacts of magnet 551, brush 553, strapped terminals of the arc engaged by the brush 553 and over the lower No. 2 back contact of relay 514 to battery through the winding of magnet 551. Magnet 551 thereupon quickly advances the brushes 552 and 553 four steps until brush 552 engages the eleventh terminal of its arc, at which time, the previously traced self-interrupted circuit of magnet 551 extends over the strapped Nos. 11, 12, 13 and 14 terminals of the arc associated with brush 552 and the upper No. 3 contacts of relay 513*. Magnet 551 is thereupon operated to quickly advance the brushes 552 and 553 four steps until brush 552 engages the sixteenth terminal of its arc at which time the previously traced self-interrupting circuit of magnet 551 extends over the strapped terminals 15 to 22, inclusive, of the arc associated with brush 552 and over the upper No. 2 contacts of relay 513*.

With brush 551 engaging the No. 23 or last terminal of its arc, at which time the second overtime period starts, the previously traced circuit for relay 514 is established and relay 514 upon operating causes the advance of the brushes of register 550 to stop, causes the sender to be associated with the trunk, the seizure of an idle identifier and the association thereof with the trunk and causes the identifier to again identify the calling line and to select the message register thereof for operation, all in the manner previously described. When the sender is associated with the trunk, relay 419 operates and causes the operation of stepping magnet 551 preparatory to again advancing the switch 550. In the manner previously described, the message register MR of the calling line is controlled to make two charges for the second overtime period of one minute, after which the identifier and sender are released as previously described.

When the sender releases, relay 419 of the trunk releases in turn releasing magnet 551 to advance the brushes of switch 550 into engagement with the normal or No. 1 terminals of their arcs. Relay 514 now releases. Since it has been assumed that the conversation is still continuing at this time, the brushes of the switch 550 are advanced through another half revolution first under the control of interrupter 519 to measure the second overtime interval of one minute, previously charged, and then under the control of zone relay 513* in the manner previously described.

When brush 552 again engages the last terminal of its arc, relay 514 is again operated and causes the seizure of a sender and an identifier and the operation of the identifier to again identify the calling line and to select the message register thereof for operation. When the sender is associated with the trunk, relay 419 operates and causes the operation of stepping magnet 551 preparatory to again advancing the switch 550. In the manner previously described the selected message register MR of the calling line is controlled to make two charges for the third overtime period of conversation, after which the identifier and sender are released as previously described.

When the sender releases, relay 419 of the

trunk releases in turn releasing magnet 551 to advance the brushes of register 550 into engagement with the normal or No. 1 terminals of their arcs. Relay 514 now releases and the switch 550 is advanced first under the control of interrupter 519 to measure the third overtime interval of one minute, previously charged for, and then under the control of zone relay 513^x in the manner previously described. It will be assumed that during this advance of the switch 550, the calling subscriber hangs up to terminate the conversation, whereupon relay 504 releases in turn releasing relay 416. Relay 416 upon releasing releases relay 414 which upon releasing releases relay 422 and removes ground from conductor 433, thereby releasing relay 501. Relay 416 upon releasing also removes ground from conductor 437 thereby releasing operated overtime relay 515 and zone relay 513^x. With relay 501 released a circuit for restoring the brushes of switch 550 to their normal positions is established from ground over the lower back contact of relay 501, through the interrupter contacts of magnet 551, brush 553 and the strapped terminals of its arc over the lower No. 2 back contact of relay 514 to battery through the winding of magnet 551. Relay 416 upon releasing removes ground from the sleeve conductor 107 of the trunk thereby initiating the release of the line finder 101 and selector switches 102, 103 and 104. When the called subscriber hangs up, relay 505 releases in turn releasing relay 503 which in turn releases relay 511. The digit register 400 of the trunk has been restored to normal by the release magnet 419 at the time the trunk was first disconnected from a sender. This restoring circuit may be traced from battery through the winding of release magnet 402 of the register, over the lower No. 4 back contact of relay 419, over the lower back contact of relay 415 and the upper back contact of relay 417 to ground over the upper contact of the off-normal contact set 500, such circuit being opened at the off-normal contact set when the brush of the register reaches normal position. All operated apparatus of the trunk is now in its normal condition.

Had the zone relay 513¹ been operated on the call just described indicating a call to the No. 1 zone of the exchange area, then for the initial period of the conversation, with overtime relay 515 unoperated, the previously traced circuit for the charging relay 1176 of the identifier would have been established to operate the message register MR once for making a single charge for such initial period. By referring to the preceding table, it will be noted that for a call to the No. 1 zone, a single charge is made for each overtime period of four minutes duration or fraction thereof. Accordingly, with overtime relay 515 operated the previously traced circuit extending from ground over the upper back contact of relay 1141 of the identifier to the lower armature of relay 515, is extended over the front contact thereof, over the lower No. 1 contacts of zone relay 513¹, conductor 527, the No. 8 contacts of identifier trunk connector relay 601F, conductor 1178 strapped over terminals of cross-connecting rack 1127 to conductor 1147, thence through the winding of charging relay 1176 of the identifier would have been established to operate the message register MR once for each overtime period. To measure four minutes for the overtime period, the upper No. 4 front contact of relay 513¹ is strapped to terminal 523 and the upper Nos. 2 and 3 front contacts are left disconnected so

that during the advance of brush 552 of switch 550 to measure the overtime period, the brush is advanced over terminals 3 to 6, inclusive, under the control of the fifteen seconds interrupter 519 to measure the first minute, is advanced rapidly in a self-interrupting circuit extending over the upper No. 4 contacts of relay 513¹ into engagement with the No. 11 terminal of its arc, and is then advanced under the control of interrupter 519 over the remaining terminals of its arc to measure an additional three minutes.

In a similar manner the other zone relays 513² and 513³ (not shown) would control the charging circuits of the identifier during the initial period of conversation over their lower No. 2 contacts to make two and three charges respectively and would control the charging circuits of the identifier during each overtime period of conversation over their lower No. 1 contacts to make one and two charges respectively. To time the overtime period for a call to the No. 2 zone, zone relay 513² would have its upper Nos. 3 and 4 front contacts connected to terminals 523 and 524 and its upper No. 2 front contact left disconnected so that the switch brush 552 would be advanced under the control of interrupter 519 over terminals 3 to 6, inclusive, of its arc and over terminals 15 to 22, inclusive, of its arc to measure three minutes of overtime and would be operated rapidly in a self-interrupting circuit over terminals 7 to 14 of its arc and over the front contacts of relay 513². To time the overtime period for a call to the No. 3 zone, zone relay 513³ would have its upper Nos. 2 and 3 front contacts connected to terminals 524 and 525 and its No. 4 front contact left unconnected so that the switch brush 552 would be advanced under the control of interrupter 519 over terminals 3 to 10 of its arc to measure two minutes of overtime and would be operated rapidly in a self-interrupting circuit over terminals 11 to 22 of its arc and over the front contacts of relay 513³.

From the foregoing discussion, it will be seen that a very slight modification of automatic ticketing circuits is required to render them capable of controlling zone and overtime message registration. While the invention has been described in connection with a system employing switches of the step-by-step type, it is to be understood that the invention is not limited in its application to systems of such type but is equally applicable to systems employing other types of switching apparatus. Furthermore the invention might be employed in exchange areas in which no automatic ticketing is to be done in which case the senders and identifiers used could be much simplified by the omission of all equipment not required for controlling message registration on a zone and overtime basis.

What is claimed is:

1. In a multioffice exchange system divided into a plurality of zones, a plurality of calling lines having message registers, a plurality of called lines terminating in offices located in different zones of the system, means including a trunk for establishing a connection from any calling line to any one of said called lines, a timing switch associated with said trunk for measuring the initial and overtime periods of conversation, means operable in accordance with the office code digits of the called line number dialed by the calling subscriber for determining the zone in which the called line terminates, means for identifying the calling line, a message register selector, means controlled by said timing switch

during the initial and each overtime period of conversation for causing said identifying means to identify said calling line, means responsive to each line identification to operate said selector in accordance therewith to select the message register of the identified line and means operable under the control of said zone determining means and said timing switch to operate the selected message register.

2. In a multioffice exchange system divided into a plurality of zones, a plurality of calling lines having message registers, a plurality of called lines terminating in offices located in different zones of the system, means including a trunk for establishing a connection from any calling line to any one of said called lines, a timing switch associated with said trunk for measuring initial and overtime periods of conversation, means operable in accordance with the office code digits of the called line number dialed by the calling subscriber for determining the zone in which the called line terminates, zone registering means in said trunk selectively operable by said zone determining means, means for identifying the calling line, a message register selector, means controlled by said timing switch during the initial and the overtime periods of conversation for causing said identifying means to identify said calling line, means responsive to each line identification to operate said selector in accordance therewith to select the message register of the identified line, and means operable under the joint control of said zone registering means and said timing switch to operate the selected message register upon each selection thereof.

3. In a multioffice exchange system divided into a plurality of zones, a plurality of calling lines having message registers, a plurality of called lines terminating in offices located in different zones of the system, means including a trunk for establishing a connection from any calling line to any one of said called lines, a timing switch associated with said trunk for measuring the initial and overtime periods of conversation, means operable in accordance with the office code digits of the called line number dialed by the calling subscriber for determining the zone in which the called line terminates, zone registering means in said trunk selectively operable by said zone determining means, means for identifying the calling line, a message register selector, means controlled by said timing switch during the initial and overtime periods of conversation for causing said identifying means to identify said calling line, means responsive to each line identification to operate said selector in accordance therewith to select the message register of the identified line and means operable under the joint control of said zone registering means and said timing switch to operate the selected message register in one manner upon the selection thereof during the initial period of conversation and in a different manner upon the selection thereof during each overtime period of conversation.

4. In a multioffice exchange system divided into a plurality of zones, a plurality of calling lines having message registers, a plurality of called lines terminating in offices located in different zones of the system, means including a trunk for establishing a connection from any calling line to any one of said called lines, a timing switch associated with said trunk for measuring the initial and overtime periods of conversation, means operable in accordance with the office code digits of the called line number dialed

by the calling subscriber for determining the zone in which the called line terminates, means for identifying the calling line having a plurality of registers for registering the digits of the directory number of an identified calling line, a message register selector, means controlled by said timing switch during the initial and each overtime period of conversation for causing the identifying means to identify said calling line and to operate said selector in accordance with the setting of its digit registers to select the message register of the identified line and means operable under the control of said zone determining means and said timing switch to operate the selected message register in one manner upon the selection thereof during the initial period of conversation and in a different manner upon the selection thereof during overtime periods of conversation.

5. In a multioffice exchange system divided into a plurality of zones, a plurality of calling lines having message registers, a plurality of called lines terminating in offices located in different zones of the system, means including a trunk for establishing a connection from any calling line to any one of said called lines, a timing switch associated with said trunk for measuring the initial and each overtime periods of conversation, zone register relays and an overtime relay associated with said switch, a plurality of calling line identifying means, means for associating one of said identifying means with said trunk upon the seizure thereof, means in said identifier responsive to the office code digits of the called line number dialed by the calling subscriber for selectively operating one of the zone register relays of said trunk, means for thereafter releasing said identifying means, a message register selector, means controlled by said timing switch during the initial and each overtime period of conversation for associating an identifying means with said trunk and for causing said identifying means to identify the calling line, means responsive to each line identification to operate said selector in accordance therewith to select the message register of the identified calling line and means operative in accordance with the zone and overtime relays operated to operate the selected message register.

6. In a multioffice exchange system divided into a plurality of zones, a plurality of calling lines having message registers, a plurality of called lines terminating in offices located in different zones of the system, means including a trunk for establishing a connection from any calling line to any one of said called lines, a timing switch associated with said trunk for measuring the initial and each overtime period of conversation, zone register relays associated with said switch for controlling said switch to measure initial and overtime periods of different duration and for determining the number of charges to be made for the initial and each overtime period, an overtime relay operable upon the termination of an initial period of conversation, a plurality of calling line identifying means, means for associating one of said identifying means with said trunk upon the seizure thereof, means in said identifying means responsive to the office code digits of the called line number dialed by the calling subscriber for selectively operating one of the zone register relays of said trunk, means for thereafter releasing said identifying means, a message register selector, means controlled by said timing switch during the initial

and each overtime period conversation for associating an identifying means with said trunk and for causing said identifying means to identify the calling line, means responsive to each line identification to operate said selector in accordance therewith to select the message register of the identified calling line, and means operative under the joint control of said zone and overtime relays to operate the selected message register one or more times for the initial period and one or more times for each overtime period of conversation in accordance with the zone into which the calling line has been extended.

7. In a multioffice exchange system, divided into a plurality of zones, a plurality of calling lines having message registers, a plurality of called lines, terminating in offices located in different zones of the system, means including a trunk for establishing a connection from any calling line to any one of said called lines, a timing switch associated with said trunk for measuring the initial and each overtime period of conversation, zone register relays and an overtime relay associated with said trunk, a plurality of calling line identifying means, means for associating one of said identifying means with said trunk upon the seizure thereof, means in said identifying means responsive to the office code digits of the called line number dialed by the calling subscriber for selectively operating one of the zone register relays of said trunk, means for thereafter releasing said identifying means, a message register selector, means controlled by said timing switch during the initial and each overtime period of conversation for associating an idle identifying means with said trunk and for causing said identifying means to identify the calling line, means responsive to each line identification to operate said selector in accordance therewith to select the message register of the identified calling line, and a group of slow-releasing relays selectively operable and releasable in cascade in accordance with the zone and overtime relays operated to operate the selected message register one or more times during the initial period of conversation and one or more times during overtime period of conversation.

8. In a multioffice exchange system divided

into a plurality of zones, a plurality of lines having message registers, a plurality of called lines terminating in offices located in different zones of the system, means including a trunk for establishing a connection from any calling line to any one of said called lines, a timing switch associated with said trunk for measuring the initial and overtime periods of conversation, means operable in accordance with the office code digits of the called line number dialed by the calling subscriber for determining the zone in which the called line terminates, a plurality of calling line identifying means, a message register selector comprising certain selecting relays common to said identifying means and other selecting relays individual to said identifying means, means controlled by said timing switch during the initial and each overtime period of conversation for causing an identifying means to identify the calling line, means responsive to each identification of said calling line to associate the common selecting relays of said selector with the identifying means being used and to operate the relays of said selector to select the message register of the identified calling line, and means operative in accordance with the zone determining means and said timing switch to operate the selected message register.

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