

June 13, 1944.

C. F. SEIBEL

2,351,551

TELEPHONE SYSTEM

Filed May 29, 1943

10 Sheets-Sheet 1

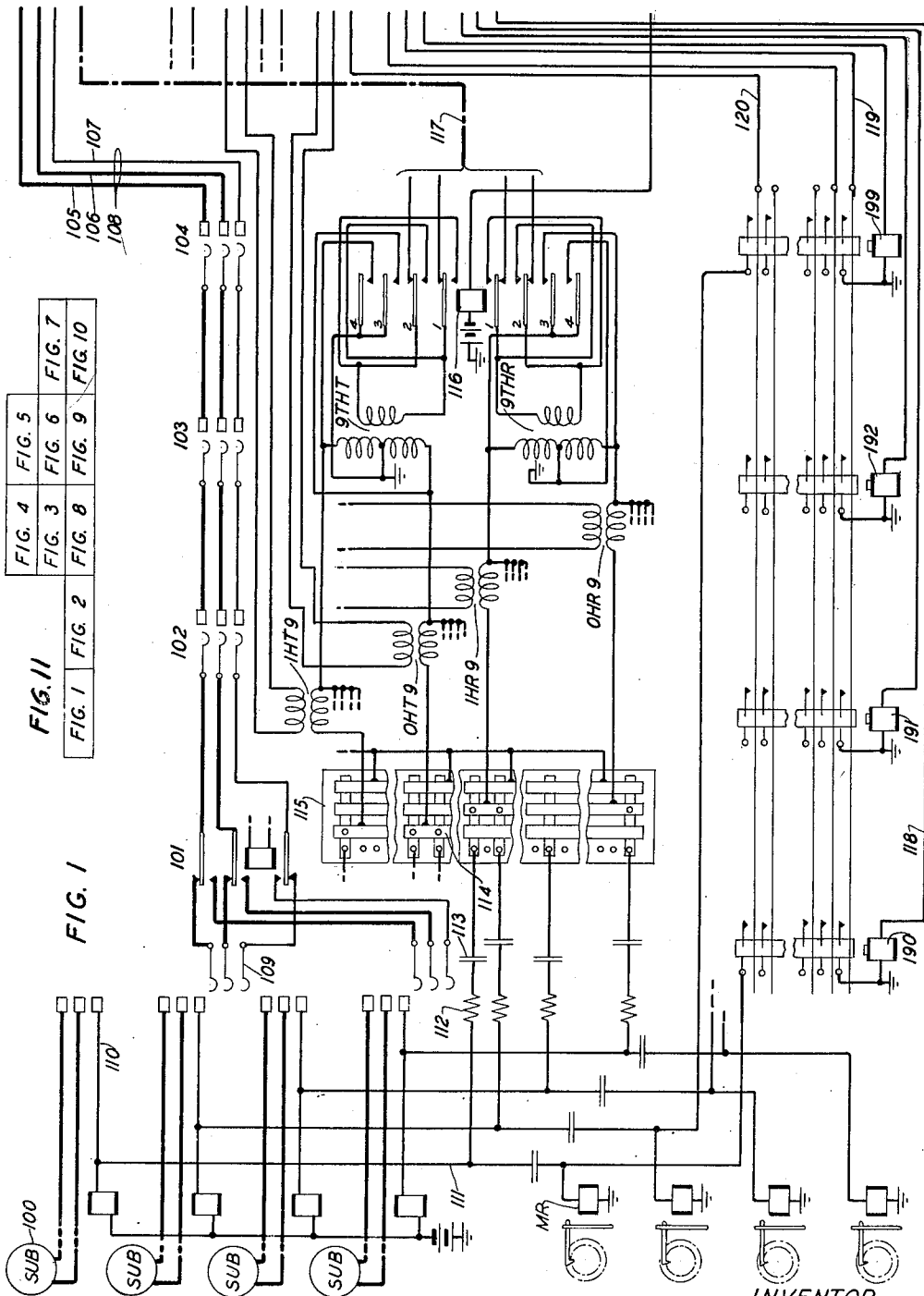


FIG. 11

FIG. 1	FIG. 2	FIG. 3	FIG. 4	FIG. 5	FIG. 6	FIG. 7	FIG. 8	FIG. 9	FIG. 10

FIG. 1

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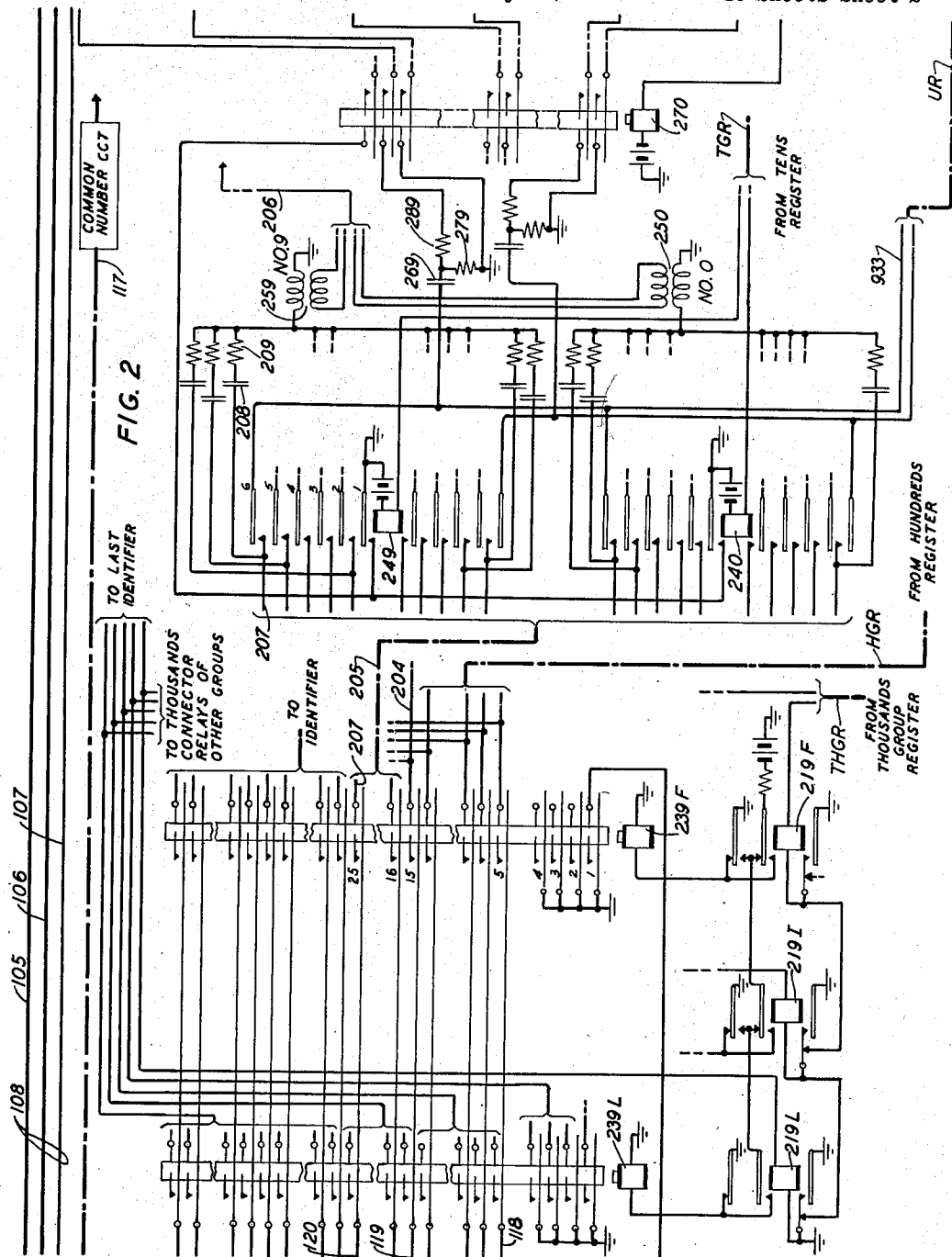
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TELEPHONE SYSTEM

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10 Sheets-Sheet 2



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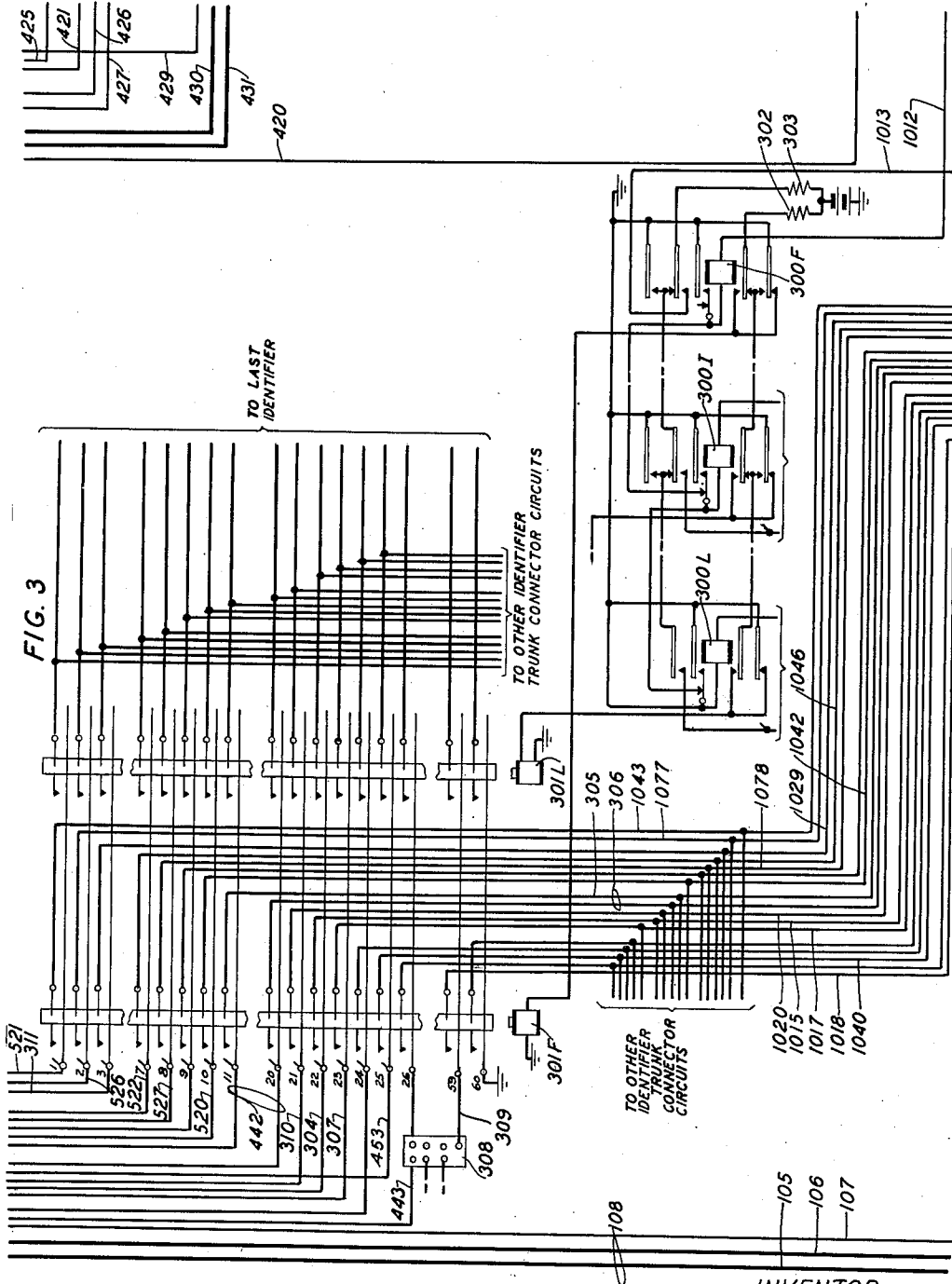
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10 Sheets-Sheet 3



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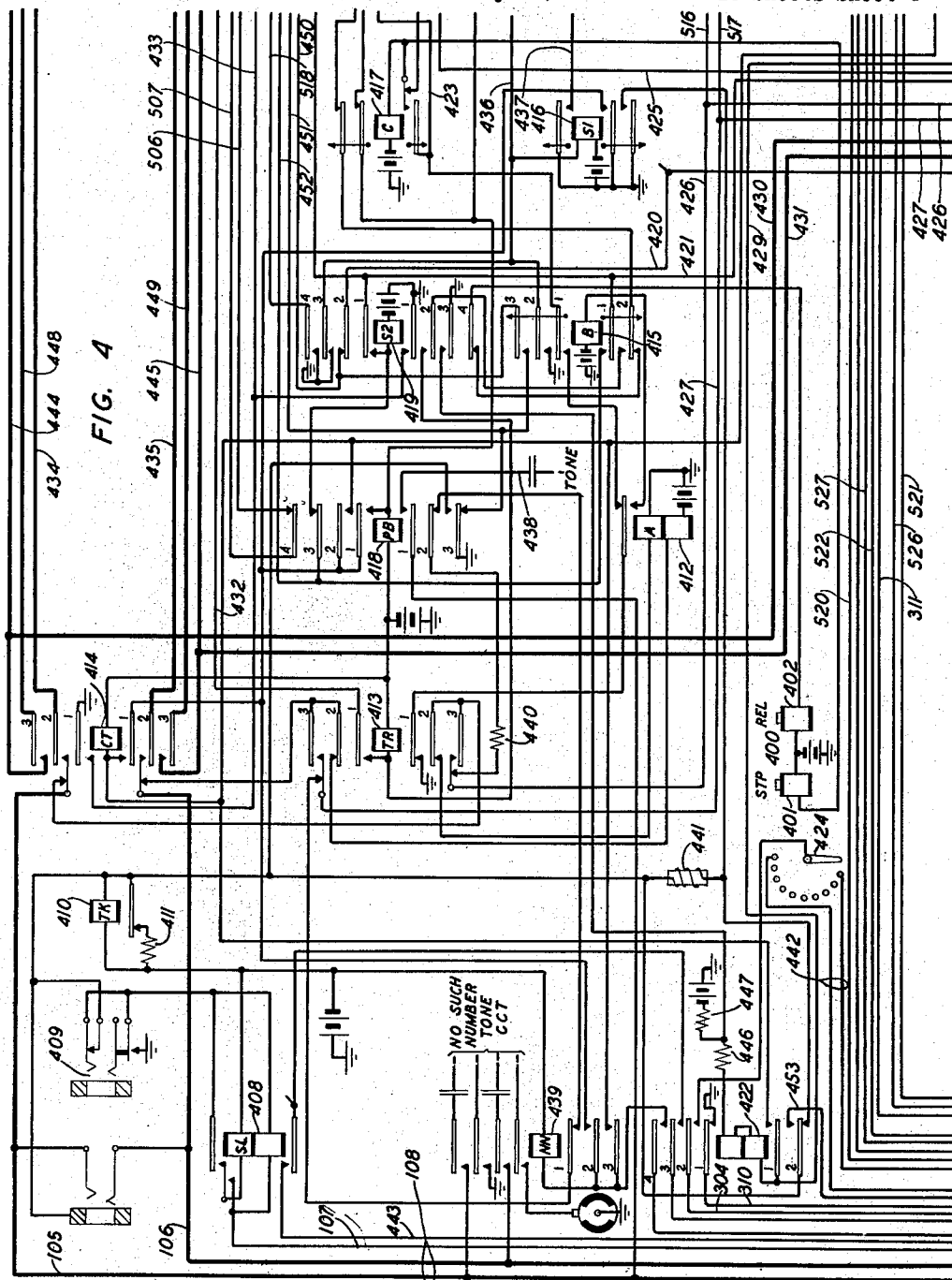
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10 Sheets-Sheet 4



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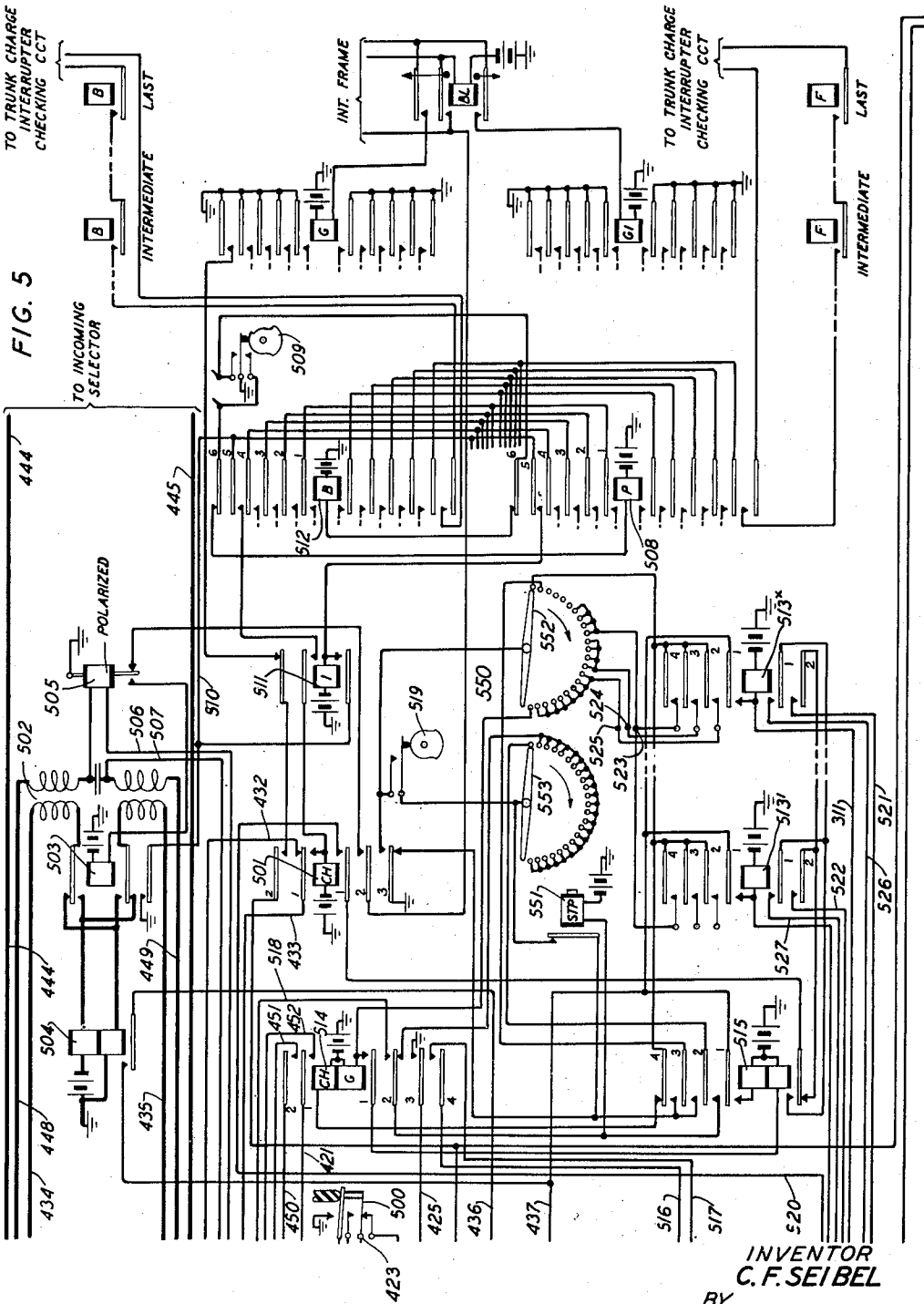
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TELEPHONE SYSTEM

Filed May 29, 1943

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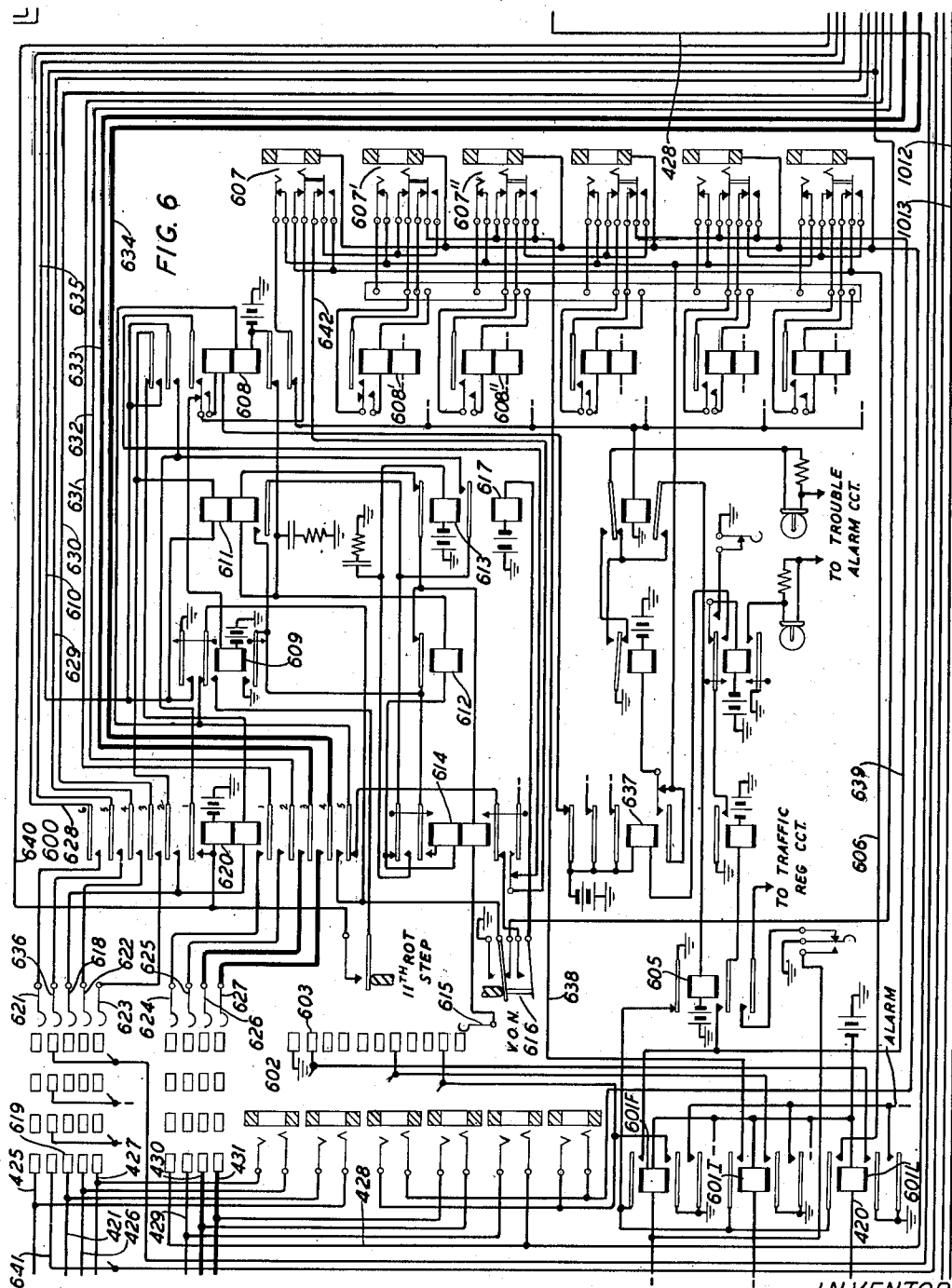
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10 Sheets-Sheet 7

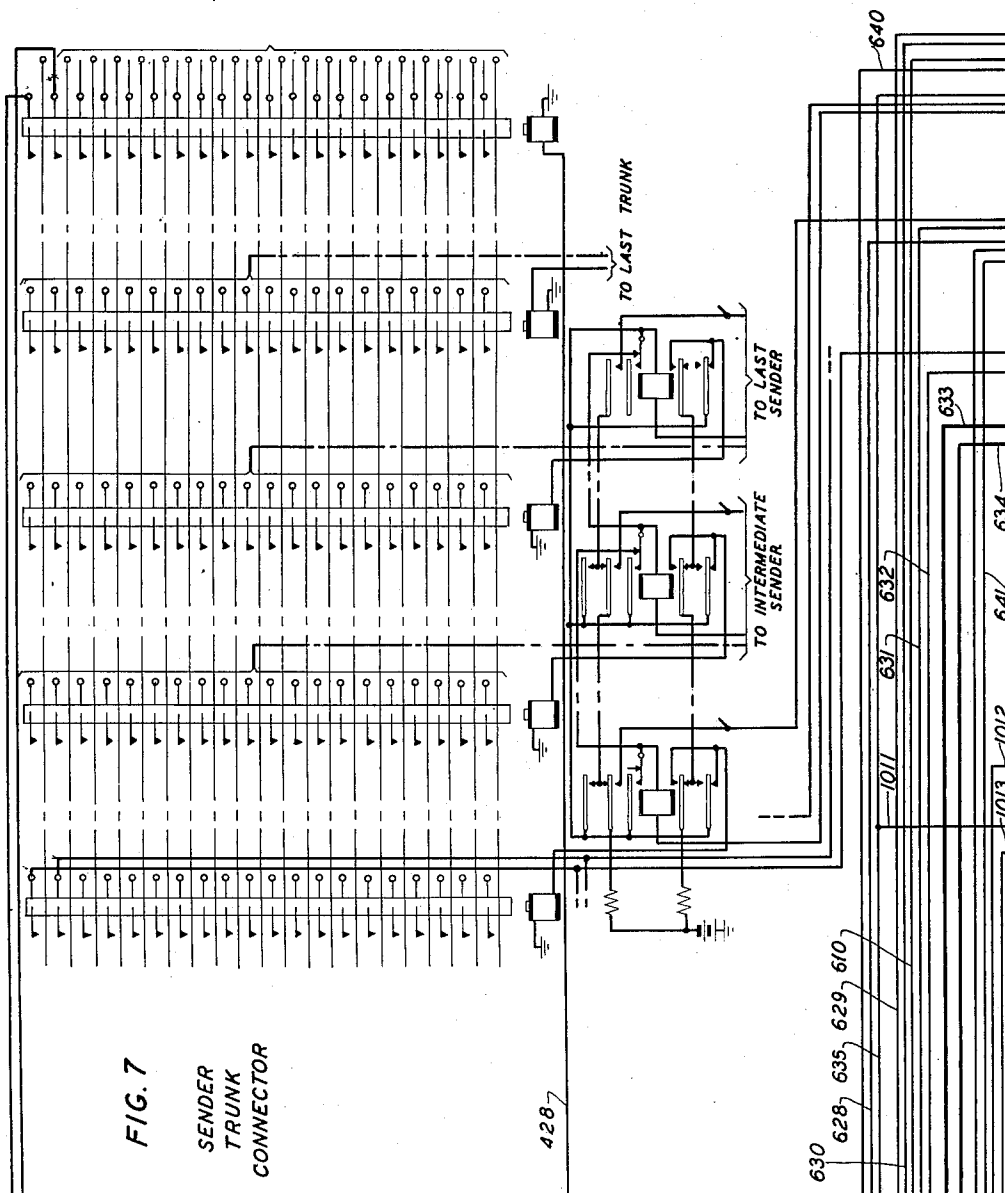


FIG. 7

SENDER
TRUNK
CONNECTOR

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10 Sheets-Sheet 8

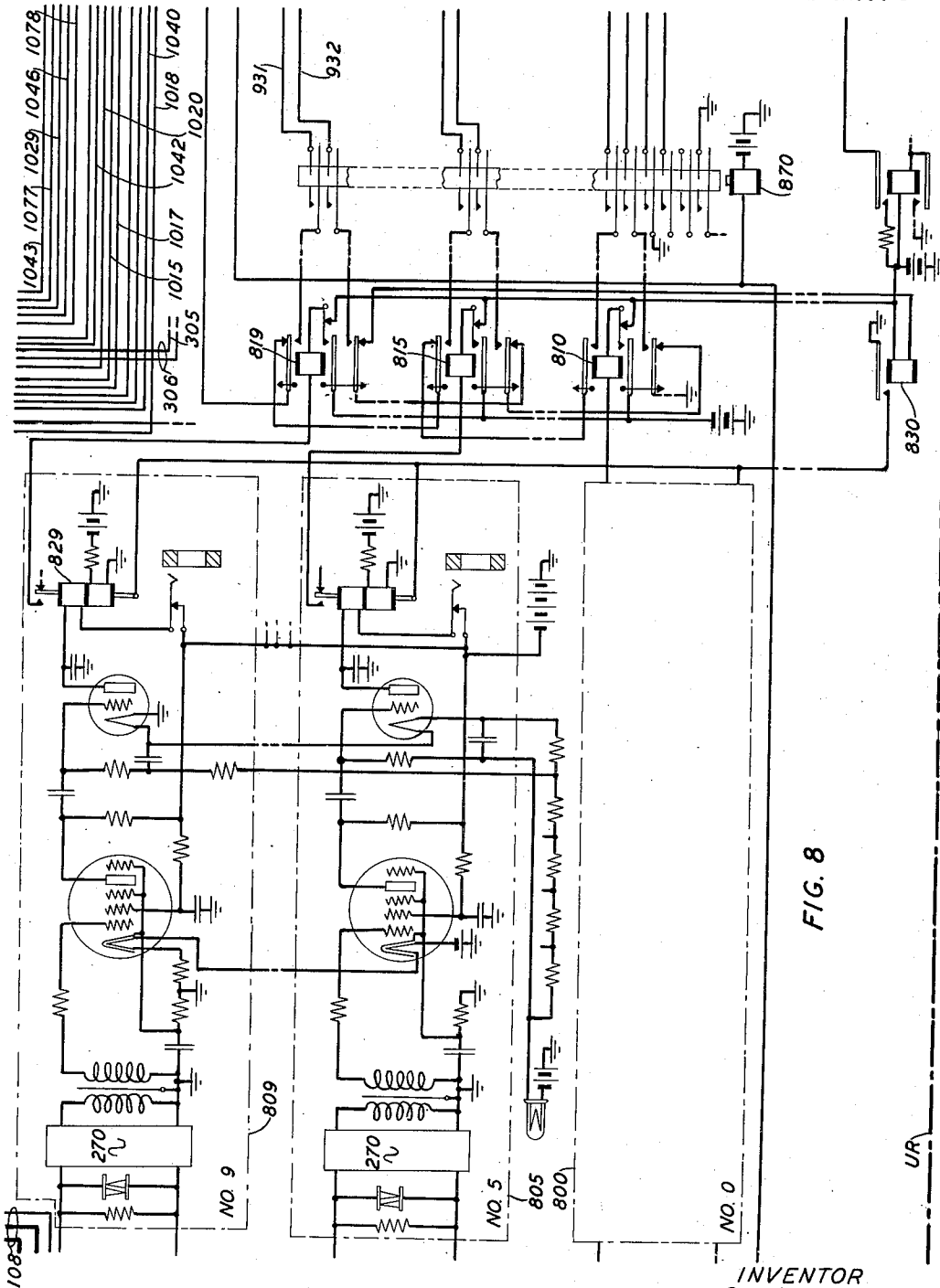


FIG. 8

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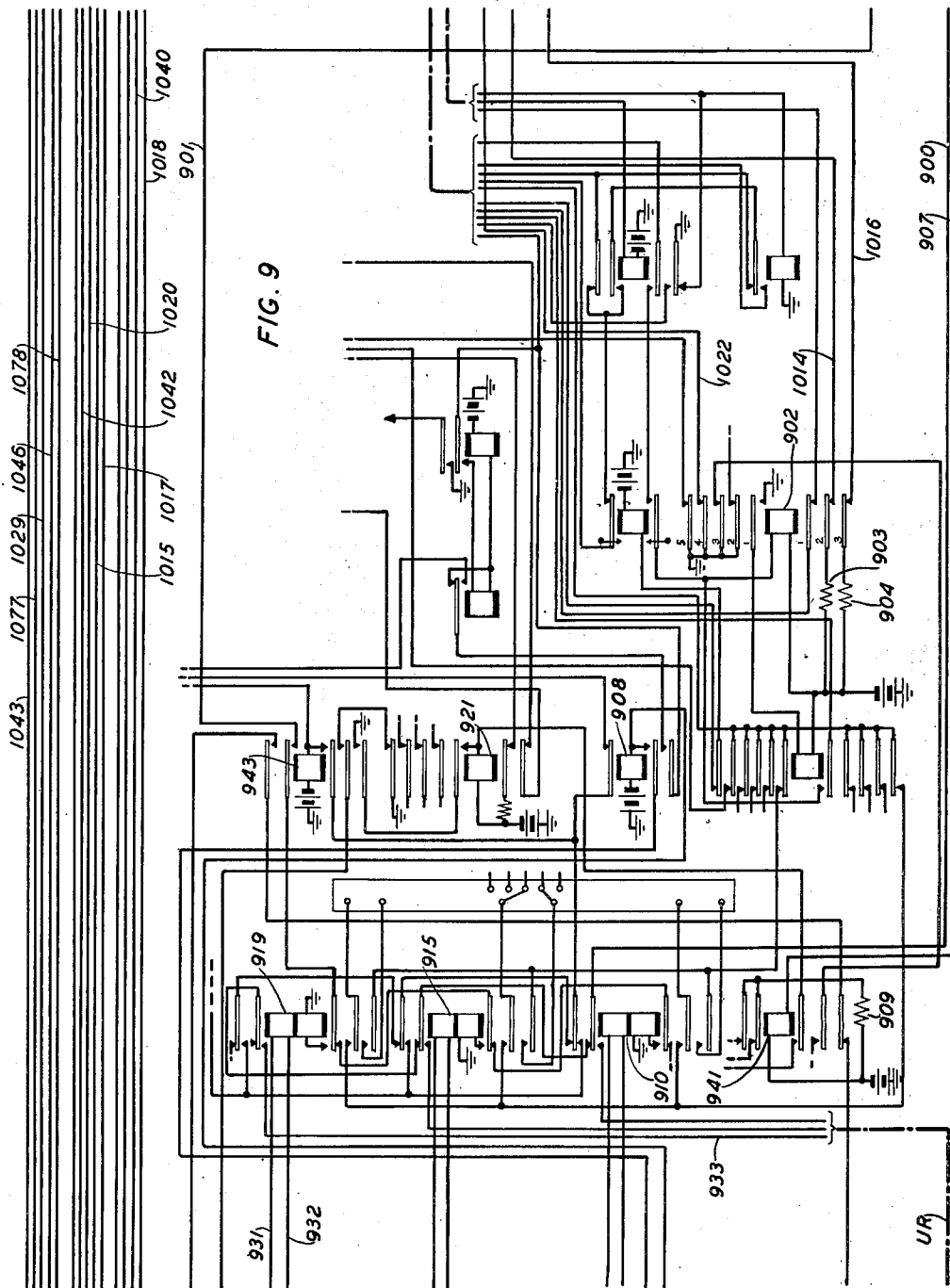
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10 Sheets-Sheet 10

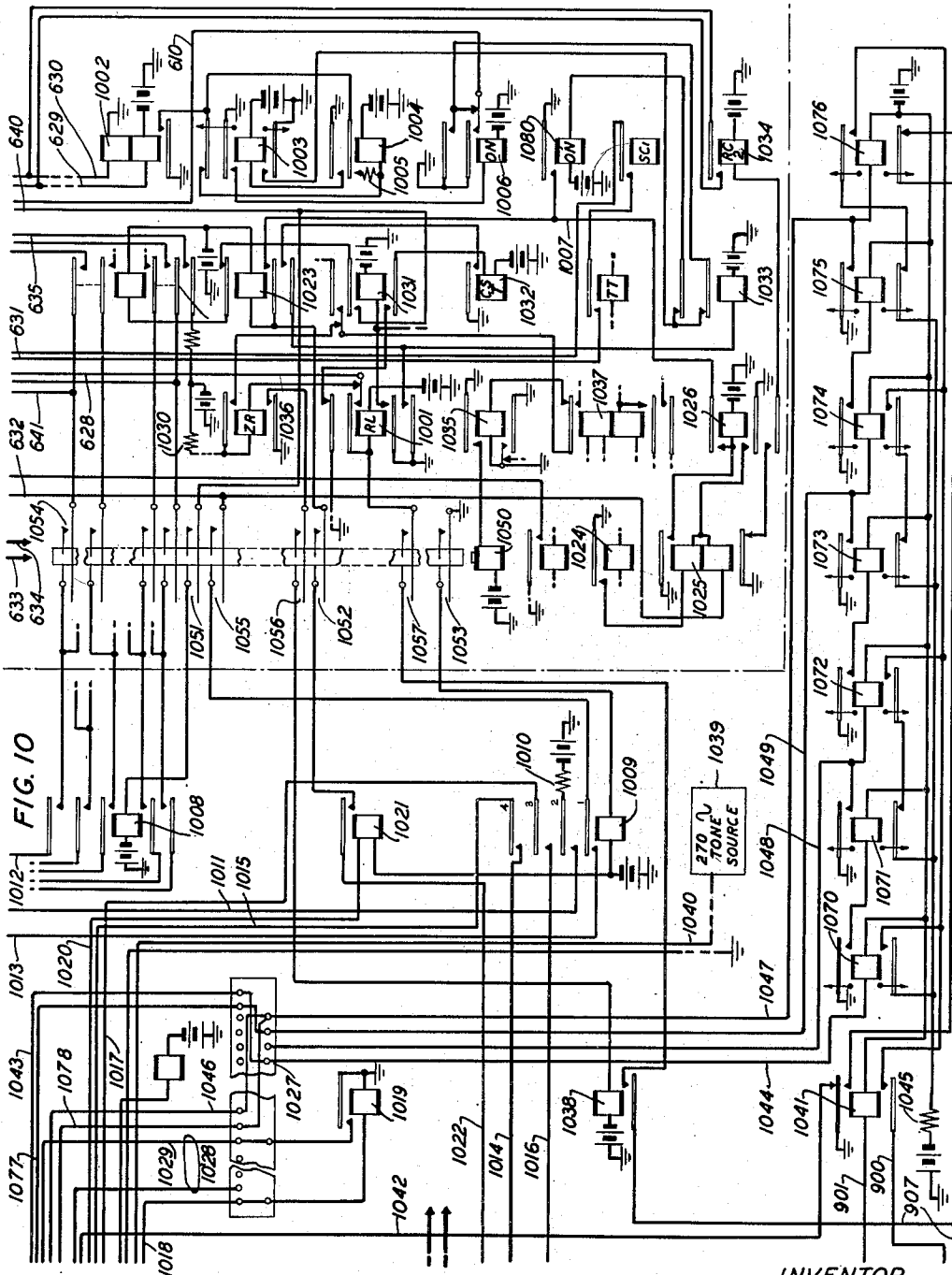


FIG. 10

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UNITED STATES PATENT OFFICE

2,351,551

TELEPHONE SYSTEM

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Application May 29, 1943, Serial No. 489,013

4 Claims. (Cl. 179-7.1)

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 an established connection 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 in the existing central office line and switch-

ing 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 identification, 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 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 not only is it available for performing its automatic ticketing function 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 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. During the initial and each overtime period of conversion the timing circuit 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 selects the register of the calling line over the connector relays of the thousands number circuit, and tens group connector relay and units register relay of the identifier operated during the identification of the calling line and operates such register in accordance with the zone, initial and overtime registrations in the trunk. The invention is an improvement over the system disclosed in the copending application of W. H. Matthies, Serial No. 490,568, filed June 12, 1943, in that no additional message register connector is required.

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 drawings 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 group digits of the calling line, the units identifying pads of one of the identifiers and one of the switching relays of an identifier;

Fig. 3 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;

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

Fig. 7 shows a sender-trunk-connector for connecting any seized sender with the trunk which has seized the sender;

Figs. 8 and 9, the portion of Fig. 10 to the left of the dot-dash line 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. 8 showing in the right portion thereof a switching relay and in the left portion thereof amplifier and detector circuits connectable to several portions of the identifier circuits through the operation of the switching relays for detecting the presence of signaling current on the connected sleeve conductor of any calling line and register relays associable with the detector circuit; and Fig. 9 showing register circuits for registering the units digits of the calling line number;

Fig. 10 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; and

Fig. 11 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 600 of Fig. 6 is of the double brush step-by-step type.

The thousands number circuit disclosed in part in Figs. 1 and 2 is identical with the similar circuit 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. 10 is substantially identical with that disclosed in full in the Gooderham application except that two relays 1036 and 1001 have been added together with associated circuit connections for enabling the sender to function properly on calls requiring zone and overtime message reg-

ister 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 1050 of the Fig. 10 is identical with that disclosed in full in the Gooderham application except that provision is made for the extension of two control conductors from the identifier to the sender for use in connection with the added relays 1036 and 1001 of the sender. The sender-trunk-connector of Fig. 7 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 600 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. 3 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 600 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 (not shown) 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 contact 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 415, 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.

its inner upper contacts thereby establishing a circuit from battery through its upper winding over such contacts, the lower contacts of rotary magnet 613, contacts of relay 611 to ground over the lower contacts of relay 609. Both of its windings being now energized, relay 620 fully operates to extend control conductors 425 to 431, inclusive, of the trunk over brushes 621 to 627, inclusive, of the trunk finder and the upper Nos. 3, 4 and 6 and lower Nos. 1 to 4 contacts of relay 620 to conductors 628 to 634, inclusive, extending to the sender; to cause the operation of relay 608 in a circuit extending from ground over the off-normal springs 616, the lower No. 5 front contact of relay 620, through the lower winding of relay 608 to battery and ground; to connect sender conductor 635 over its upper No. 5 contacts and brush 636 to conductor 641 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 contacts another point in the circuit of release magnet 617 and to prepare a locking circuit for itself over its upper No. 1 front contact which will be effective following the operation of relay 608.

Relay 608, upon operating, extends trunk conductor 421 over terminal 619 and brush 618, the upper No. 2 contacts of relay 620 and the upper front contact of relay 608 to conductor 610 extending to the sender; completes the locking circuit of relay 620 extending from battery through the upper winding and upper No. 1 contacts of relay 620, over the middle upper contacts of relay 608 to ground on conductor 610; transfers at its inner upper contacts the in-start conductor 606 from the winding of start relay 609 to the out-start conductor 642 and through its upper winding to battery at the upper back contact of relay 637; at its inner lower back contact removes battery from the windings of relays 611 and 614 and from the vertical magnet 612 and at its upper front contact shunts the upper winding of relay 611. Relays 611 and 614 now release and relay 609, being slow to release, releases after an interval sufficient to allow ground to be applied to conductor 610 at the sender to hold relay 620 and relay 419 of the trunk operated.

When relay 614 releases the continuity of the out-start conductor 642 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 606 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 606, over the middle normal contacts of test jack 607, the inner upper front contact of relay 608, the lower normal contacts of relay 614, conductor 642, the inner normal contacts of test jack 607, the middle normal contacts of test jack 607' associated with the second trunk finder of the same trunk finder group, thence over the upper normal contacts of relay 608' to the start relay of such second finder corresponding to relay 609. Had such second finder of the subgroup of finders been busy and consequently relay 608' 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 607', the middle normal contacts of test jack 607'', 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 608'', of such finder to the start relay thereof.

In a similar manner the in-start conductors 606, 638, 639, 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 No. 2 front contacts 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 is later operated. 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 relays 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 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 to battery, over the lower back contact of

relay 503 and 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 426, 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 416 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 1002 of the sender, over conductor 630, the upper No. 3 contacts of relay 620 and brush 623 of trunk finder 600, 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 622 and the upper No. 4 contacts of relay 620 of the trunk finder 600, conductor 629 and thence to ground through the upper winding of relay 1002. Relay 1002 operates over this circuit and establishes a circuit from ground over its contacts, the back contact of relay 1003 and through the winding of relay 1004 to battery and relay 1004 thereupon operates and locks through resistance 1005 and over its front contact to ground at the front contact of relay 1002 and at its upper front contact closes an obvious circuit for slow-to-release relay 1003. Relay 1003, upon operating, establishes obvious circuits for off-normal relays 1006 and 1080, relay 1006 upon operating connecting ground to conductor 610 to replace the ground applied thereto by relay 609 of trunk finder 600 which latter relay releases after the trunk finder has found the calling trunk. Relay 1080 upon operating connects ground to the off-normal ground conductor 1007.

After the operation of transfer relay 413, conductor 426 of the loop circuit previously traced through the windings of relay 1002 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 1002 is placed under the control of the calling subscriber. In response to the dialing of the hundreds, tens and units digits of the wanted line number, dial impulse responsive relay 1002 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. 8 and 9, the right portion of Fig. 2 and the left portion of Fig. 10, is associated with the sender by a sender-

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 610 by the sender, over the upper middle contacts of relay 608, the upper No. 1 contacts of transfer relay 620, conductor 640, contacts 1051 of sender-identifier-connector relay 1050 to battery through the winding of relay 1008 in the identifier. Relay 1008 thereupon operates. Start relay 1009 of the identifier is also operated in a circuit established over contacts 1053 of the sender-identifier-connector relay 1050 and establishes a circuit from battery through resistance 1010 over its No. 2 contacts, conductor 1011, conductor 635, over the upper No. 5 contacts of relay 620 and brush 636 of trunk finder 600, conductor 641, contacts 1054 of sender-identifier-connector relay 1050, contacts of relay 1008, conductor 1012, through the winding of lock-out relay 300F, 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 300I and 300L allocated to other identifiers to ground. Relay 300F operates, locks over its upper inner alternate contacts to ground, establishes an operating circuit for the multicontact relay 301F from ground through the winding of such relay over the inner lower front contact of relay 300F, through resistance 302 to battery, and establishes a circuit from battery through resistance 303, over its middle upper front contacts, conductor 1013, over the No. 1 contacts of identifier start relay 1010, contacts 1055 of the sender-identifier-connector relay 1050, conductor 632, over the lower No. 2 contacts of relay 620 and brush 625 of the trunk finder 600, 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 301F of the identifier-trunk-connector and relay 422 of the trunk finder both operate. Relay 301F extends a plurality of control conductors from the calling line 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 903, over the inner lower No. 2 back contact of relay 902, conductor 1014, the No. 4 contacts of relay 1009, conductor 1015, the No. 22 contacts of identifier-trunk-connector relay 301F, conductor 304, 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 301F, conductor 305 of group 306, 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 904, over the lower No. 3 back contact of relay 902, conductor 1016, the No. 3 contacts of relay 1009, conductor 1017, the No. 23 contacts of relay 301F, conductor 307, the upper No. 3 contacts of relay 422, the lower contact of the sleeve relay of the 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 308 to conductor 309, over the No. 59 contacts of relay 301F, conductor 1018 through the winding of route relay 1019 to ground. Route relay 1019, 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 310, over the No. 21 contacts of relay 301F, conductor 1020, through the winding of relay 1021 to battery and ground whereupon relay 1021 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 1021, upon operating, establishes a circuit from ground over the upper No. 4 back contact of relay 902, conductor 1022, contacts of relay 1021, contacts 1052 of the sender-identifier-connector relay 1050 to battery and ground through the winding of relay 1023 of the sender, which relay upon operating locks over its inner lower contacts to the off-normal ground conductor 1007 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 633, the lower No. 3 contacts of relay 620 and brush 626 of the trunk finder 600 and conductor 430 to the tip conductor 444 of the outgoing trunk and over conductor 634, the lower No. 4 contacts of relay 620 and brush 627 of the trunk finder 600 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 1024 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 1025 in series, thence as traced over conductor 632, 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 1025 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 1025 of the sender. Relay 1025 now operates but relay 414 does not operate and relay 1025 upon operating causes the operation of relay 1026 which locks over its upper contact to ground on the off-normal ground conductor 1007 and closes a shunt around the upper winding of relay 1025. With the upper winding of relay 1025 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 1019 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 1027 to a conductor of the group 1028 extending over contacts of the identifier-trunk-connector relay 301F to battery through windings of the zone register relays 513' to 513^x 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 1019 establishes a connection from ground over its contacts strapped over terminals of rack 1027 to conductor 1029, over the No. 3 contacts of relay 301F and conductor 311 through the winding of zone register relay 513^x to battery and ground. Relay 513^x thereupon operates and locks over its upper No. 1 contacts and conductor 437 to ground over the upper contacts of relay 416. Thus zone register relay 513^x remains operated throughout the duration of the conversation and until the calling subscriber releases the connection.

The identifier having operated its no-ticketing relay 1021 as an indication that no ticket is required and having operated no-ticketing relay 1023 of the sender, proceeds to operate relay 1031 without waiting to identify the calling line and relay 1031 upon operating opens the circuit of relay 1035 which releases in turn releasing the sender-identifier-connector relay 1050 to release the identifier which in turn releases the identifier-connector relay 301F 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 subgroup 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 contacts 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 1002 operated and establishes a circuit from ground over its lower No. 3 contacts, conductor 425, brush 621 and the upper No. 6 contacts of relay 620 of the trunk finder 600, conductor 628, over the inner upper normal contacts of relay 1001 through the winding of relay 1036 and through resistance 1030 to battery and ground. Relay 1036 thereupon operates and establishes a circuit from battery through resistance 1030 over its upper contacts over the normal contacts of relay 1031 and the upper back contact of relay 1037 to ground through the winding of relay 1035 which upon operating causes the operation of sender-identifier-connector relay 1050 to associate an idle identifier with the sender. The identifier then proceeds to connect itself over the identifier-trunk-connector relay 301F with the calling trunk. Relay 1036 upon operating and with relay 1050 operated establishes a circuit from ground over its lower contacts and contacts 1056 of relay 1050 to battery through the winding of relay 1038 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 re-

lay 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 1021 as previously described. Since the no-ticketing relay 1021 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 1039 is applied over conductor 1040, the No. 25 contacts of identifier-trunk-connector relay 301F, 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.

In the manner fully described in the Gooderham application hereinbefore referred to, the amplifier-detector circuits 800 to 809, inclusive, are first associated with the secondary windings of the thousands coils of the thousands number circuit appertaining to the calling office and with the thousands group register relays 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 1039 will therefore flow through the primary winding of the No. 0 hundreds coil 0HT9 to ground through the primary winding of the No. 9 thousands coil 9THT and will be induced into the secondary winding of coil 9THT to cause the response of the amplifier-detector circuit 809 and the operation of a relay in the thousands group register circuit of the identifier. In response to the operation of this relay a circuit is established over a conductor of cable THGR 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 the lock-out relays 219I and 219L allocated to other identifiers, thence to ground if no other identifier has at the 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.

After the thousands group connector relay 239F has been operated, the identifier proceeds in the manner fully described in the Gooderham application to associate the secondary windings of all of the hundreds transformer coils 0HT9 to 9HT9 of the No. 9 thousands group with the amplifier-detector circuits 800 to 809 over contacts of the operated thousands group relay 239F and the amplifier-detector circuits are also associated with the hundreds group register circuit of the identifier. It having been assumed that the calling line is located in the No. 0 hundreds group, the signaling current applied to the sleeve conductor of the calling line will be applied to the primary winding of the hundreds transformer coil 0HT3 and will be induced into the secondary winding of such coil and applied to the input side of the amplifier-detector circuit 800. This circuit will thereupon respond and cause the hundreds group register to register the hundreds digit 0.

With a relay of the hundreds group register operated to register the hundreds digit 0, a circuit is established by such relay over a conductor of cable HGR over the No. 5 contacts of the thousands group connector relay 239F and over conductor 119 to ground through the winding of hundreds group connector relay 190. Relay 190 operates over this circuit to connect the sleeve conductors of the one hundred lines of the No. 0 hundreds group over its contacts and the contacts of the operated thousands group connector relay 239F to the tens transformer coils shown in the right portion of Fig. 2. Over its lower contacts relay 190 also establishes a circuit over conductor 119, over the No. 15 contacts of relay 239F and conductor 204 to prepare the tens group register circuit for operation.

As previously stated, when the hundreds group connector relay 190 operated and with the thousands group connector relay 239F operated, the sleeve conductors of one hundred lines are extended over contacts thereof and 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 ten 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 transformer coils 250 to 259, inclusive, are connected over conductors of cable 206 to the input sides of the amplifier-detector circuits 800 to 809, through the operation of a switching relay as fully disclosed in the Gooderham application. It has been assumed that the tens digit of the calling line number is 9 and that the units digit is also 9 and that therefore the signaling current on the sleeve conductor of said line is conducted over contacts of relays 190 and 239F and conductor 207 of cable 205 through condenser 208 and resistance 209 and the primary winding of the No. 9 transformer coil 259 to ground. This signal current is induced into the secondary winding of coil 259 and is applied over conductors of cable 206 to the No. 9 amplifier-detector circuit 809 resulting in the operation of a relay in the tens group register circuit to register the tens digit 9. With this register relay operated, a circuit is established thereby extending over a conductor of cable TGR to battery through the winding of the No. 9 tens group connector relay 249.

Relay 249 upon operating connects each of the group of ten 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 digit, 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 contacts of switching relay 270 to the input side of amplifier-detector circuit 809. In response to the signal current, anode relay 829 is operated, thereby causing the operation of register relay 819.

With register relay 819 operated, a circuit is established over the contacts of switching relay 870 and conductors 931 and 932 through the upper winding of units register relay 919. Relay 919 thereupon operates and, with relay 943 previously operated, locks in a circuit from ground through its lower winding and inner lower contacts over the upper No. 1 contacts of relay 943 and conductor 901 to battery through the winding of relay 1041. Relay 1041 operates in this locking circuit and at its upper contacts prepares the circuit of relay 941. Since these identification and registration functions are all performed in identically the same manner as described in the Gooderham application, detail circuits by which these functions are carried out have been omitted to simplify the disclosure.

With thousands group connector relay 239F, hundreds group connector relay 190, tens group connector relay 249 and units register relay 919 all operated, a circuit over which the message register MR of the calling line 100 may be operated is prepared. This circuit may be traced in part from ground through the winding of the message register MR over the upper contacts of hundreds group connector relay 190, conductor 120, the No. 25 contacts of the thousands group connector relay 239F, conductor 207 of cable 205, the upper No. 6 contacts of the tens group connector relay 249, conductor 933 of cable UR over the inner upper front contact of the units register relay 919, over the inner upper back contacts of the other units register relays and over conductor 900 to the lower armature relay 1041. It is to be noted that this circuit is in large part, that is, up to the contacts of the tens group connector relay 249, the same circuit that was previously used in identifying the units digit of the calling line number.

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 measure	Overtime period charges made	Overtime period duration measure
513 ¹ -----	1	5	1	4
513 ² -----	2	5	1	3
513 ³ -----	3	5	2	2
513 ^x -----	4	5	2	1

It will be recalled that zone charge relay 513^x has been operated in the trunk and that the elapsed 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 1041, a circuit is established from ground over the upper back contact of relay 1041, conductor 1042, the No. 10 contacts of identifier-trunk-connector relay 301F, 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 301F, conductor 1043 strapped across the connecting rack 1027 to conductor 1044 and through the winding of slow-to-release relay 1070 to battery. Relay 1070 upon operating establishes the circuit of slow-to-release relay 1071 which in turn establishes the circuit of slow-to-release relay 1072. In a similar manner relays 1073, 1074, 1075 and 1076 successively operate.

When relay 1041 operates and with relay 1070

operated, the message register operating circuit previously traced to the lower armature of relay 1041 is extended over the lower front contact of such relay and the lower contacts of relay 1070, through resistance 1045 to battery for energizing the message register MR to make one charge. Relay 1041 upon operating also opens at its upper back contact the previously traced operating circuit for relay 1070 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 1071. After an interval, relay 1071 releases thereby reconnecting battery through resistance 1045 over its lower back contact, the lower front contact of relay 1072, and the lower contacts of relay 1041 to the circuit of message register circuit MR thereby again operating such register to make a second charge. Relay 1071 upon releasing also opens the circuit of relay 1072 which releases after an interval again opening the circuit of the message register at its lower contacts. Relay 1072 upon releasing also opens the circuit of relay 1073. When relay 1073 releases after an interval, it reconnects battery through resistance 1045 over the back contact of relay 1073, the lower front contacts of relay 1074 and over the lower contacts of relay 1041 to the circuit of message register MR thereby again operating such register to make a third charge. Relay 1073 upon releasing also opens the circuit of relay 1074 which releases after an interval again opening the circuit of the message register at its lower contacts. Relay 1074 releases after an interval opening the circuit of relay 1075 which also releases after a further interval and reconnects battery through resistance 1045 over its back contact, the upper contacts of relay 1076 and the lower contacts of relay 1041 to the circuit of the message register MR thereby operating such register to make a fourth charge. Relay 1075 upon releasing also releases relay 1076 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 1041 and thence over the lower back contact the relay 515 would have been extended over the inner lower contacts of zone register relay 513' assumed to be operated on such a call, over conductor 522, the No. 7 contacts of relay 301F, conductor 1046, strapped across rack 1027 to conductor 1047 and to battery through the winding of relay 1076. Therefore when relay 1041 operates as previously described, it opens the circuit of relay 1047 and battery through resistance 1045, over the back contact of relay 1075, the upper contacts of relay 1076 and the lower contacts of relay 1041, is applied to the circuit of message register MR to operate such register once during the releasing time of relay 1076. Had circuits been established through the operation of other zone register relays 513² or 513³ (not shown) of the trunk over either conductor 1048 or 1049, either relay 1072 or relay 1074 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 1076 closes its back contact it establishes the circuit of relay 941 which may be traced from battery through its winding over

conductor 907, over the lower back contacts of relay 1076 and to ground over the upper front contact of relay 1041. Relay 941 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 1076 also closes a circuit from ground over the upper front contact of relay 1041, over its lower back contact, the contacts of relay 1038, contact 1057 of the sender-identifier-connector relay 1050 to battery through the winding of release relay 1001 of the sender, whereupon relay 1001 operates, locks over its upper alternate contacts, conductor 620, the upper No. 6 contacts of relay 620 and brush 621 of trunk finder 600, conductor 425 to ground over the lower No. 3 contacts of relay 514, closes the circuit of relay 1031 which upon operating opens the circuit of relay 1050 to initiate the release of the identifier and closes at its lower contacts the circuit of release relay 1033 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 610 thereby releasing relay 620 of the trunk finder and relay 410 of the trunk. With relay 620 released, a circuit is established for release magnet 617 extending from battery through the winding of such magnet, over the lower contacts of off-normal switch 616, over the inner lower back contact of relay 614, the lower No. 5 back contact of relay 620, the upper back contact of relay 609 to ground over the upper contacts of off-normal switch 616. When the trunk finder is fully restored to normal, the contacts of switch 616 open thereby releasing the magnet 617.

At the trunk when relay 419 releases it opens the previously traced circuit of stepping magnet 551 of switch 550 whereupon 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 group start relay 601L 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 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 600 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 contact of relay 514, to conductor 421 terminating in bank terminal 619 of the trunk finder 600. When the brush 618 of the trunk finder engages terminal 619, 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 620 of the trunk finder is also operated to extend control conductors from the trunk to the sender.

A circuit is thereupon established for relay 1002 of the sender which may be traced from battery through the lower winding of relay 1002, over conductor 630, the upper No. 3 contacts of relay 620 and brush 623 of the finder 600, conductors 427 and 517, over the lower No. 4 contacts of relay 514, conductors 516 and 426, over brush 622 and the upper No. 4 contacts of relay 620 of the finder 600, conductor 629 and to ground through the upper winding of relay 1002. Relay 1002 thereupon operates followed by the operation of relays 1003, 1004, 1006 and 1080. Relay 1006 upon operating applies ground to conductor 610 to hold relay 620 in the finder and relay 419 of the trunk operated. Relay 514 also closes the previously traced circuit for relay 1036 of the sender which upon operating establishes a circuit from battery through resistance 1030 over its upper contacts, over the normal contacts of relay 1031 and the upper back contact of relay 1037 to ground through the winding of relay 1035 which upon operating causes the operation of sender-identifier-connector relay 1050 to associate an idle identifier with the trunk. The identifier then proceeds to connect itself over the identifier-trunk-connector 301F with the calling trunk. Relay 1036 upon operating and with relay 1050 operated establishes the previously traced circuit for relay 1038 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 513^x both operated, the identifier is now controlled to operate the message register MR of the identified calling line for the first overtime period 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^x 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 relays 513^x 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 301F and conductor 1077 strapped across the terminals of cross-connecting rack 1027 to conductor 1049. Thus prior to the operation of relay 1041 in the identifier

ground applied over its upper back contact and conductor 1042 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^x, thence as just traced to conductor 1049 and thence through the winding of relay 1074 to battery. Relays 1074 to 1076, inclusive, thereupon operate in succession. When thereafter relay 1041 operates, following the completion of the identification of the calling line and the selection of the message register MR of such line, relays 1074 to 1076, 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 1001 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 600 releases and, ground being removed from conductor 610, 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 conversion 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 overtime 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 contact of operated zone relay 513^x, 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^x. 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^x.

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 arc. 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^x 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 switch 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 1076 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 1041 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 301F, conductor 1078, strapped over terminals of cross-connecting rack 1027 to conductor 1047 thence through the winding of charging relay 1076 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 second interrupter 519 to measure the first minute, is advanced rapidly in a self-interrupting circuit extending over the upper No. 4 contact 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 registering 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, a calling line identifier, means controlled by said timing switch during the initial and each overtime period of conversation for causing said identifier to identify said calling line, means responsive to each line identification for establishing an operating circuit for the message register of the calling line over the line identification path through the identifier, 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 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 identifiers, means controlled by said timing switch during the initial and each overtime period of conversation for seizing an idle one of said identifiers and for connecting a source of identifying potential to a conductor of the calling line, thousands, hundreds and tens group connector relays, units register relays, means in said identifier responsive to the potential on said conductor for determining the thousands, hundreds and tens groups of lines in which the calling line conductor is located and for operating corresponding group connector relays, means in said identifier for finally locating the conductor in the selected tens group and for operating the corresponding units register relay, means responsive to the completion of each line identification for establishing an operating circuit for the message register of the calling line over the identification path to the line conductor extending over contacts of the operated units register and contacts of the operated thousands, hundreds and tens group connector relays, and means operable under the control of said zone determining means and said timing switch to operate the selected message register.

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, a plurality of calling line identifiers, means controlled by said timing switch during the initial and each overtime period of conversation for seizing an idle one of said identifiers and for connecting a source of identifying potential to a conductor of the calling line, thousands, hundreds and tens group connector relays, units register relays, means in said identifier responsive to the potential on said conductor for determining the thousands, hundreds and tens groups of lines in which the calling line conductor is located and for operating the corresponding group connector relays, means in said identifier for finally locating the conductor in the tens group and for operating the corresponding units register relay, means responsive to the completion of each line identification for establishing an operating circuit for the message register of the calling line over the identification path to the line conductor extending over contacts of the operated units register relay and contacts of the operated thousands, hundreds and tens group connector relays, and means operable under the joint 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 pe-

riod 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 at 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 'n which the called line terminates, a plurality of calling line identifiers, means controlled by said timing switch during the initial and each overtime period of conversation for seizing an idle one of said identifiers and for connecting a source of identifying potential to a conductor of the calling line, thousands and hundreds group connector relays common to a plurality of identifiers, tens group connector relays and units register relays individual to each identifier, means in said identifier respon-

5 sive to the potential on said conductor for determining the thousands group in which said conductor is located, for associating said common connector relays with said identifier and for then operating the thousands connector relay appertaining to the determined thousands group, means in said identifier for then determining the hundreds and tens groups of lines in which the calling line conductor is located and for operating 10 corresponding group connector relays, means in said identifier for finally locating the conductor in the tens group and for operating the corresponding units register relay, means responsive to the completion of each line identification for establishing an operating circuit for the message register of the calling line over the identification path 15 to the line conductor extending over contacts of the operated units register and contacts of the operated thousands, hundreds and tens group connector relays, and means operable under the control of said zone determining means and said timing switch to operate the selected message register.

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