

Sept. 5, 1944.

C. E. BROOKS ET AL

2,357,576

PAY STATION TELEPHONE SYSTEM

Filed Dec. 20, 1941

5 Sheets-Sheet 1

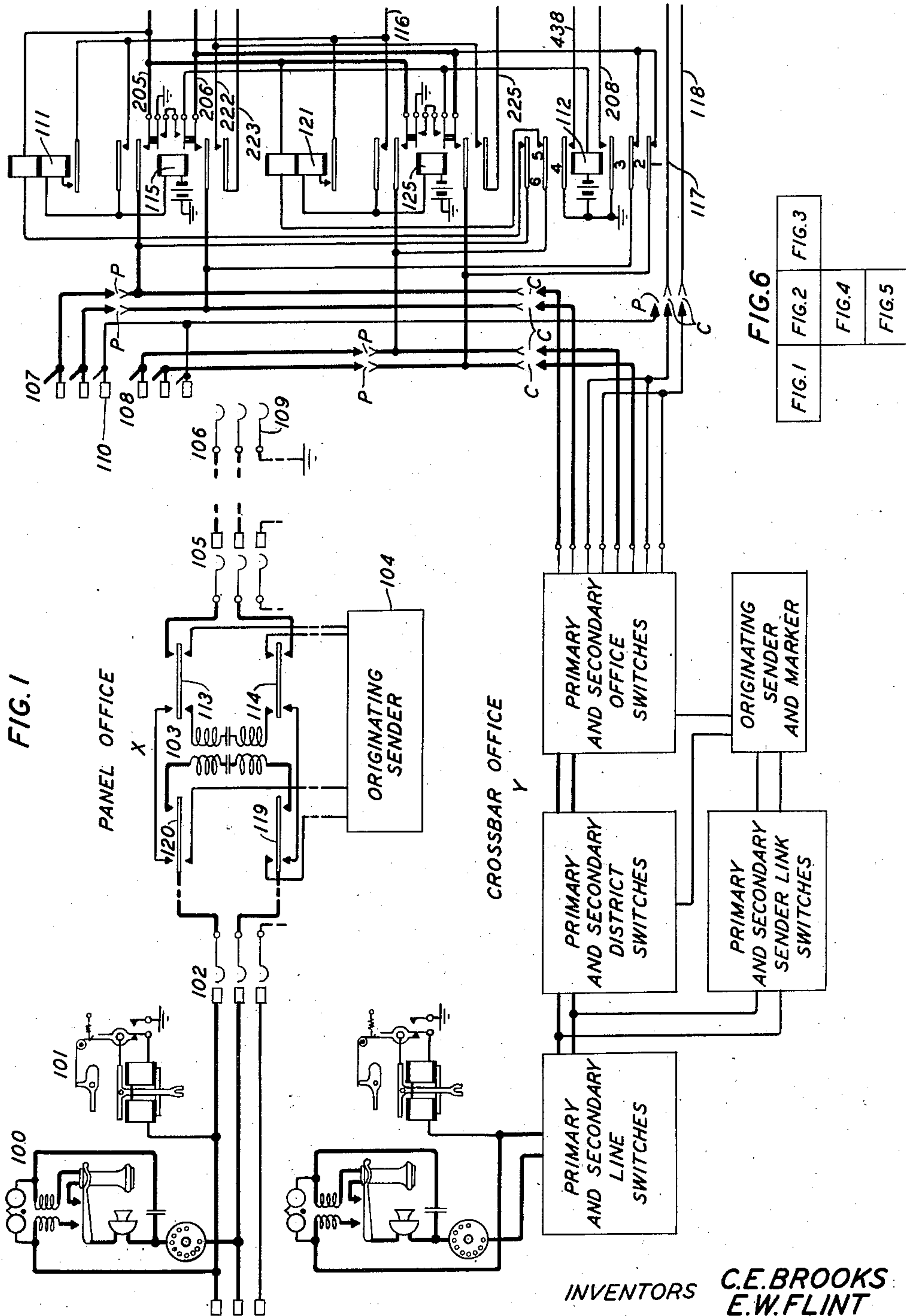
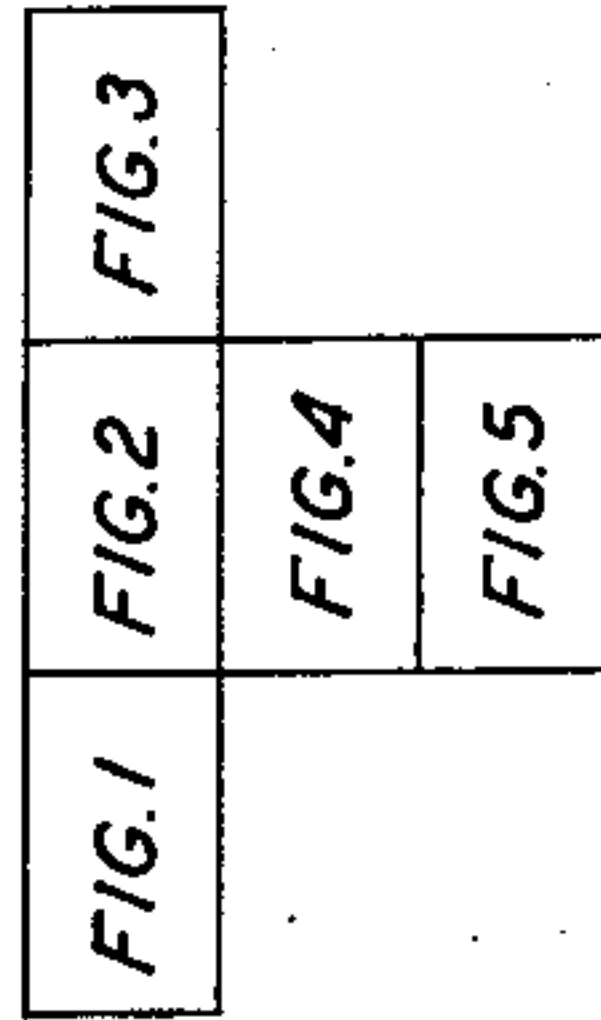


FIG. 1

FIG. 6



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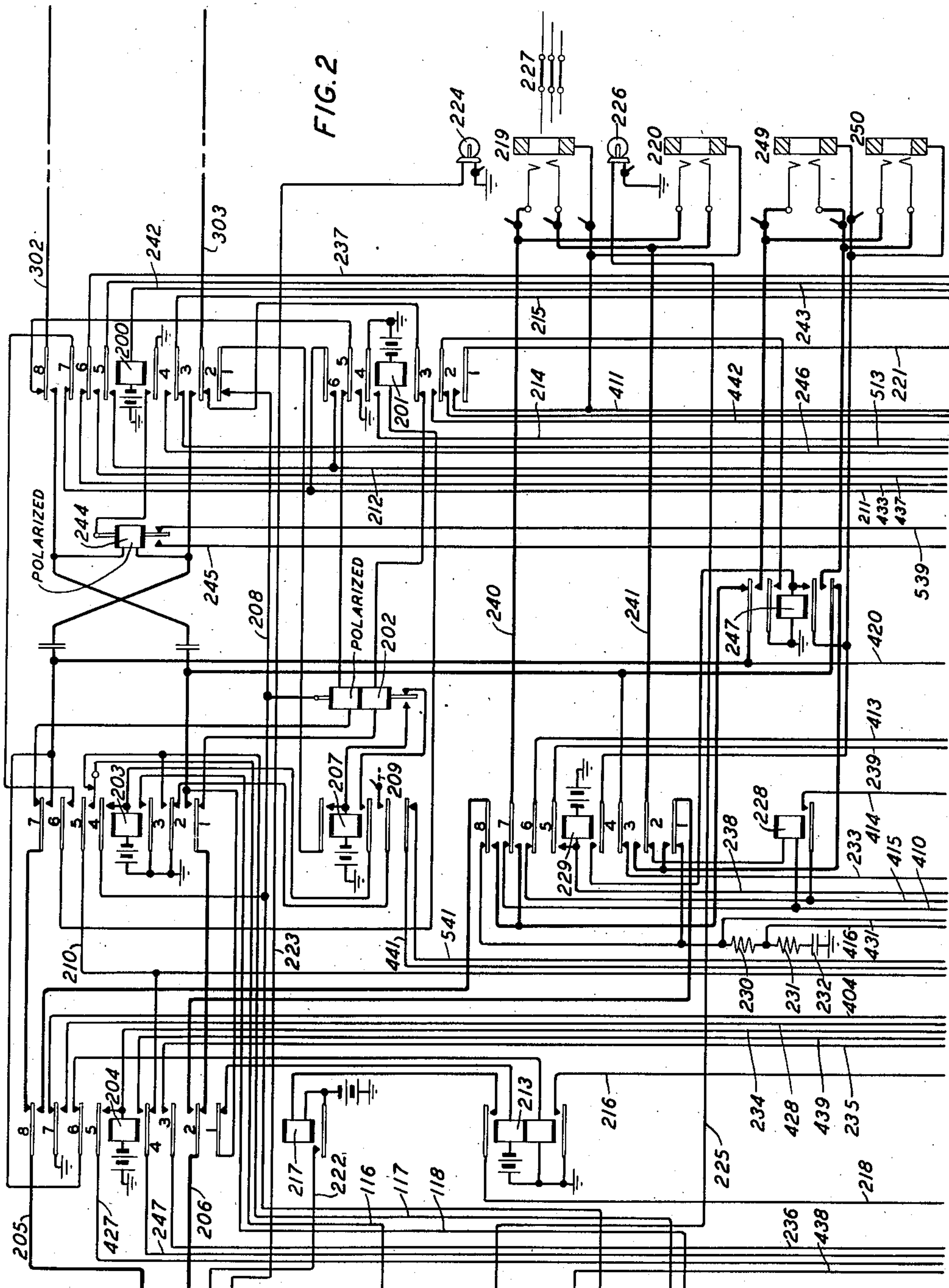
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5 Sheets-Sheet 2



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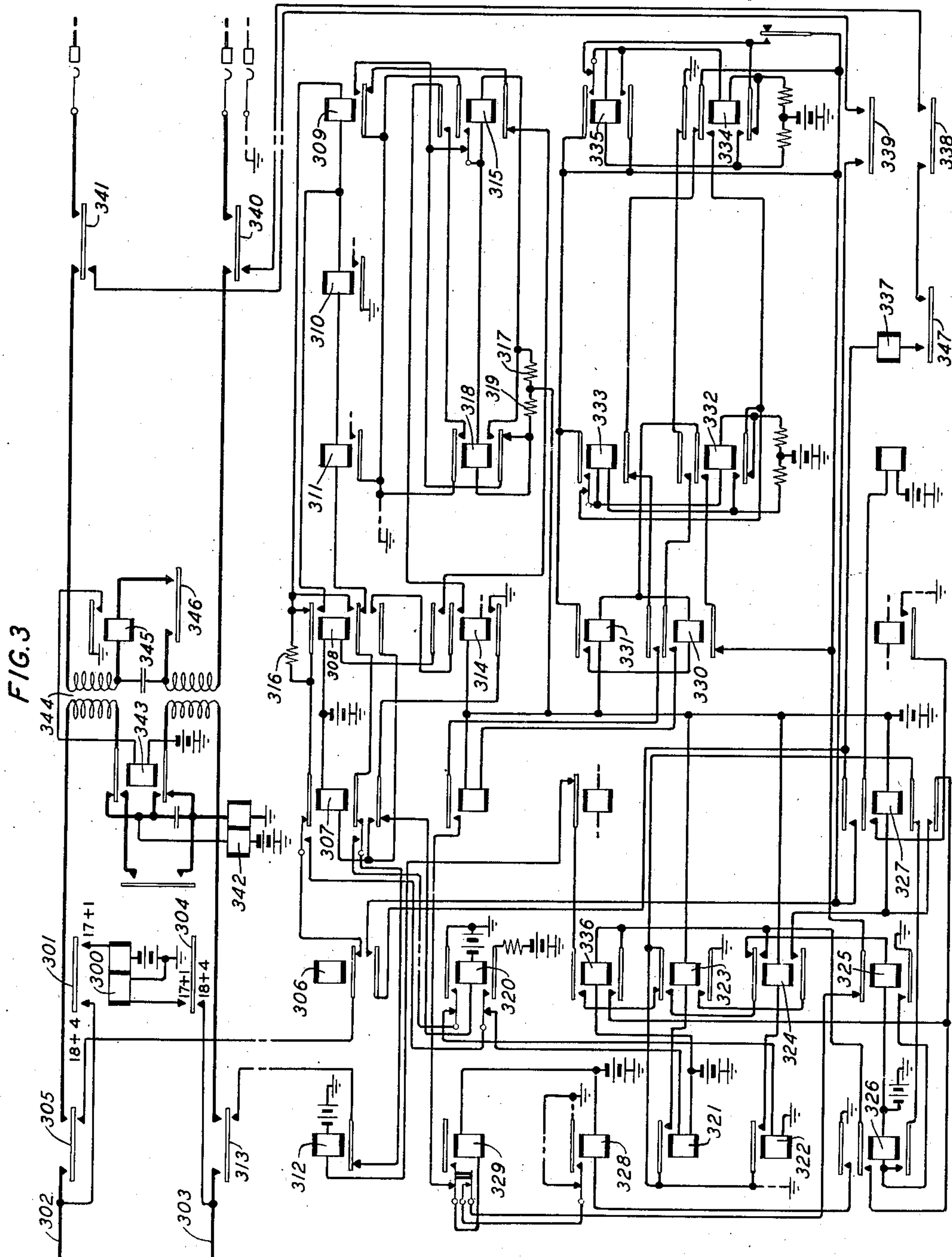
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5 Sheets-Sheet 3



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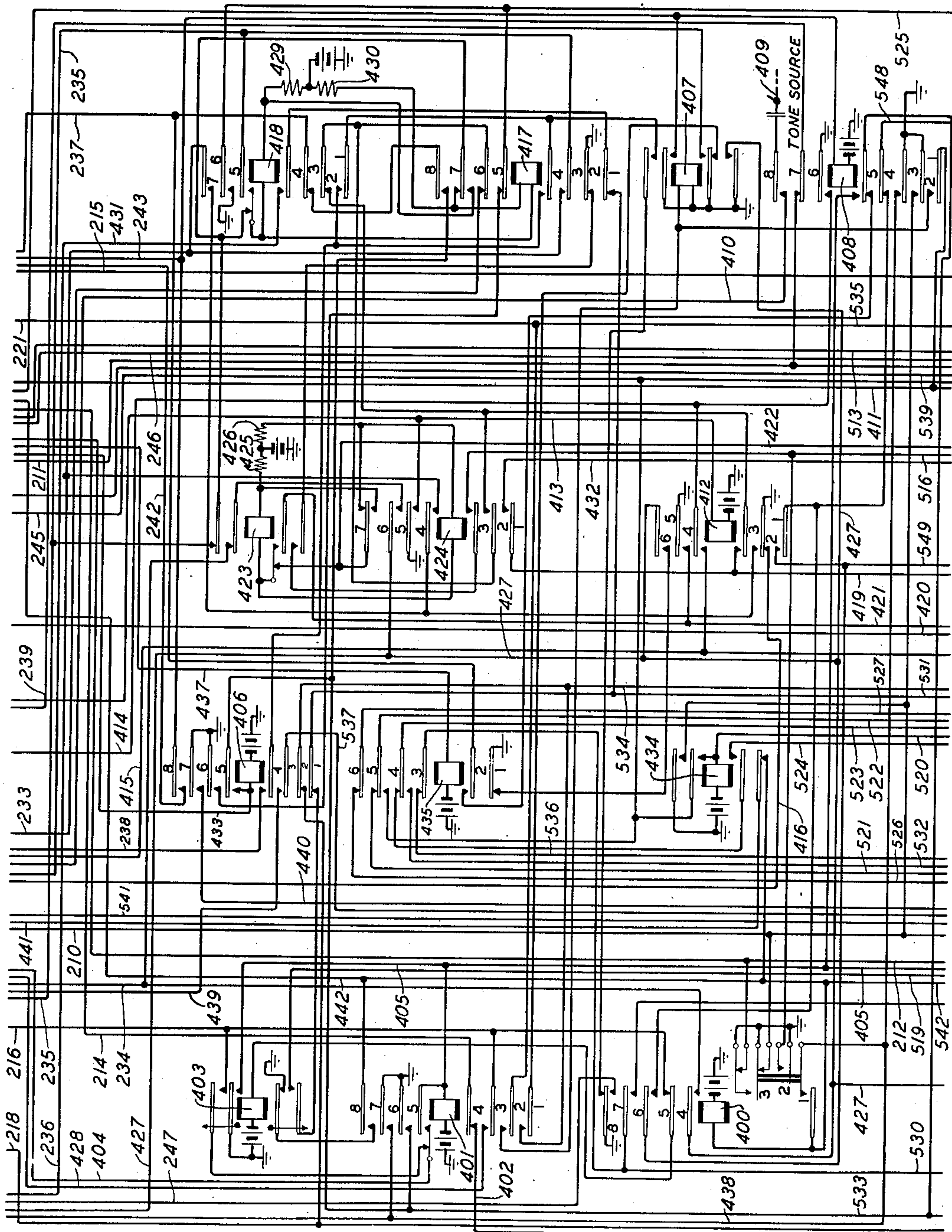


FIG. 4

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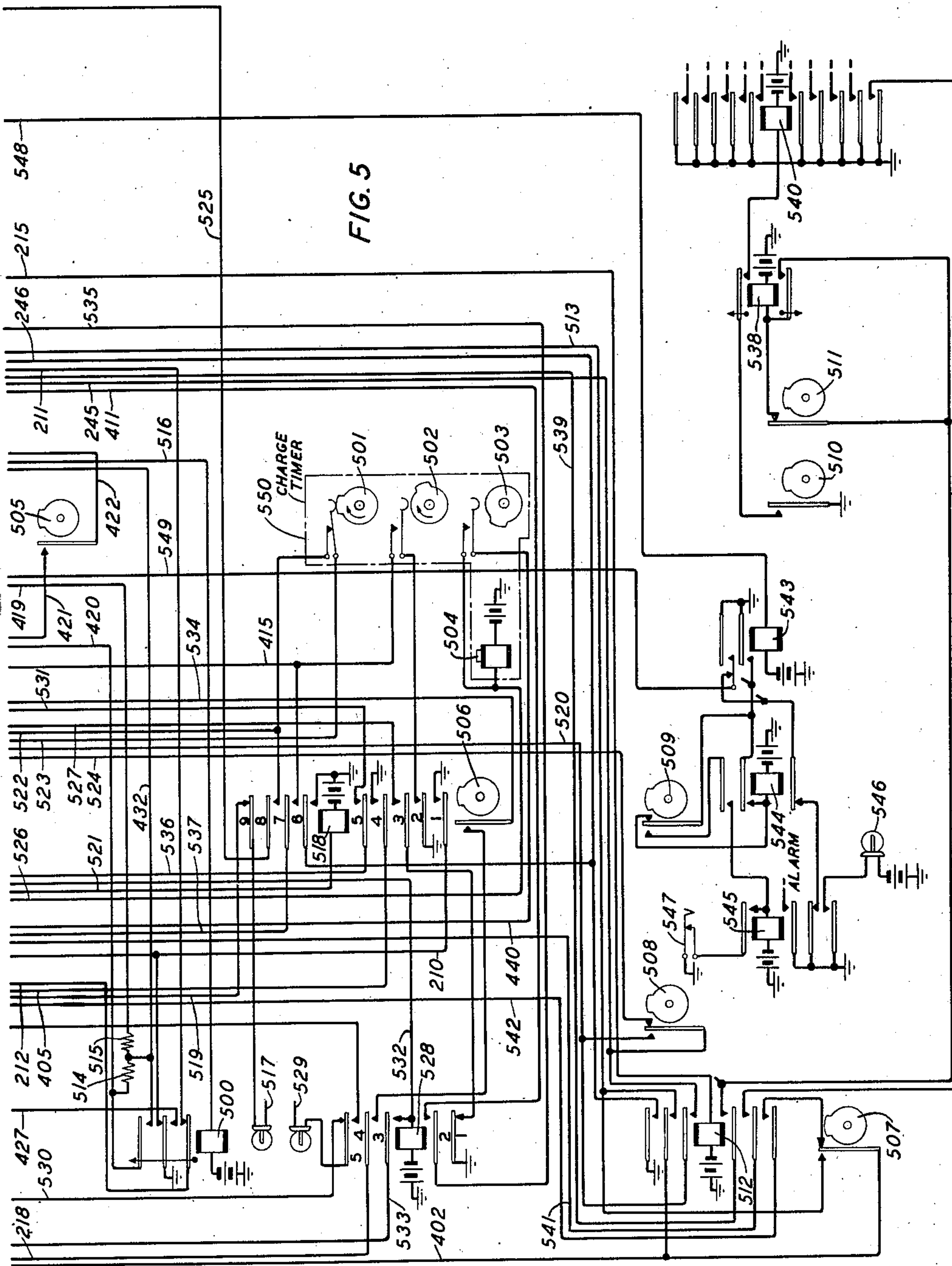
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PAY STATION TELEPHONE SYSTEM

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5 Sheets-Sheet 5



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Patented Sept. 5, 1944

2,357,576

UNITED STATES PATENT OFFICE

2,357,576

PAY STATION TELEPHONE SYSTEM

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9 Claims. (Cl. 179—6.31)

This invention relates to telephone systems and more particularly to systems in which calls from lines equipped with coin boxes are charged against the calling person through the collection of deposited coins or tokens.

In dial switching telephone systems, to enable a calling person at the substation of a line equipped with a coin box to establish calls, it has been the customary practice to instruct him to deposit a coin and if the call is one to be terminated outside of the local calling area, that is, an area requiring a toll charge, to then dial zero to secure the assistance of an "A" operator. In response to the extension of a connection to a trunk terminating at the "A" switchboard, an operator at that switchboard answers the call by plugging one of her cord circuits into the trunk jack, causes the coin box apparatus at the calling substation to refund the initially deposited coin and then requests information from the calling person concerning the desired connection. The operator then makes out a toll ticket and requests the calling person to deposit coins in payment for the initial period of conversation as determined by the tariff rate for a call to the desired destination. The operator after audibly hearing the deposit of the required coins then proceeds to establish the desired connection by dialing or keying up the digits of the desired line number or through the assistance of a recording toll operator. When the called subscriber responds, if the connection is successfully established, the operator notes the time the conversation starts on the toll ticket and times the duration of the conversation. Just prior to the expiration of the initial period, the operator challenges the calling person and informs him that if he wishes to continue the conversation he should signal her when he is through. When the operator receives such a termination signal she informs the calling person as to the additional coins which are required for the overtime period of conversation and listens for their deposit. When the conversation is terminated, all deposited coins are collected if the call was successful, or returned if not successful. From the foregoing brief description it will be apparent that on every toll call the operator is required to make out a toll ticket for timing the call and must give the call supervision throughout its duration. Also, some of the operator's time is consumed in the establishment of the connection.

It is the object of the present invention to provide facilities for handling toll calls at coin box stations whereby persons using such stations may establish short haul toll connections by dialing and whereby the services of an operator to supervise such connections for the purpose of collecting and refunding deposited coins are reduced to

a minimum and fewer operators are therefore required to handle such toll traffic.

In accordance with the present invention this object is obtained by directing all short haul, low tariff calls from coin box lines, such as ten and fifteen cent calls, to a trunk outgoing to a tandem office, such trunks having separate appearances in the banks of district or office selectors and separate lamp and jack appearances at the "A" operator's switchboard for each tariff rate. On the initiation of a call from a coin box line the calling person first deposits a coin to enable the call to be started and after receiving the usual dial tone proceeds to dial the directory number of the wanted line. The office code and numerical digits of the line number thus dialed are registered in the sender of the calling office and in accordance with the office code digits registered, a district and, if required, an office selector are set to select an idle trunk extending to a tandem office. The office code will determine over which one of its district selector or office selector appearances the tandem trunk will be seized, that is, the appearance which is allocated to the proper tariff rate for the desired connection.

At the tandem office, upon the seizure of the trunk, a connection is established with an idle tandem sender, following which the sender of the originating office is signaled to transfer the office code and numerical digit registrations of the wanted line number to registers of the tandem sender. After the number has been completely transferred, the proper charge rate lamp corresponding to the appearance over which the trunk was seized is lighted at the "A" switchboard and the "A" operator then plugs one of her cord circuits into the jack associated with the lighted lamp, whereupon the coin initially deposited is refunded and the lighted charge rate lamp is extinguished. The operator then requests the calling person to deposit coins in the amount indicated by the charge rate lamp which was lighted and after hearing the deposit of such coins, disconnects her cord circuit from the jack. When she disconnects her cord circuit from the jack the tandem sender is signaled to proceed to control the completion of the connection to the wanted line in accordance with the digit information registered therein.

When the called subscriber answers, the timing of the call is initiated and after 4½ minutes the deposited coins are collected. After five minutes the proper charge rate lamp is flashed to indicate to the operator that an overtime interval has been reached. The operator again plugs a cord circuit into the jack associated with the flashing lamp and directs the calling person to signal her when he is through talking. In most cases the subscriber will elect to terminate the conversation at once. If he does not elect to do

so, however, the operator leaves the plug of the cord circuit in the trunk jack, writes a ticket and handles the call in the manner hereinbefore described. It is thus apparent that unless the conversation extends beyond the initial period the services of the "A" operator are required but for a very brief interval and that upon a call in which the conversation extends beyond the initial period, which calls will constitute only about ten per cent of the short haul toll traffic from coin box lines, the continued supervision of the operator will be required only during the overtime period during which the conversation is continued.

For a clearer understanding of the invention, reference may be had to the following detailed description taken in connection with the accompanying drawings, in which:

Fig. 1 shows in the upper portion thereof a coin box line terminating in a panel type office, a line finder, district selector, office selector and sender of which are schematically illustrated; shows in the lower portion thereof a coin box line terminating in an office of the well-known crossbar type, the line switch, district and office selector frames, sender link switch frame, sender and marker of which are indicated by suitably labeled boxes; and shows in the right portion thereof the selector switch appearances of the outgoing end of a trunk extending from the originating office to a tandem office;

Figs. 2, 4 and 5 taken together show the outgoing end of a tandem trunk;

Fig. 3 shows in the upper portion thereof the tandem office end of the tandem trunk terminating in a tandem district selector and in the lower portion thereof such portions of a tandem sender associable with the trunk as are necessary to an understanding of the invention; and

Fig. 6 is a chart showing how the several figures of the drawings should be arranged to completely disclose the invention.

Referring to the drawings, the apparatus of the originating panel type office X, disclosed schematically in the upper portion of Fig. 1, may be of the well-known type such as is disclosed, for example, in Patent No. 1,862,549, granted June 14, 1932, to R. Raymond and W. J. Scully, and the apparatus of the originating crossbar type office Y, disclosed schematically in the lower portion of Fig. 1, may be of the well-known type such as is disclosed for example in Patent No. 2,093,117, granted September 14, 1937, to W. W. Carpenter. The interoffice tandem trunk may be used in common by a panel and a crossbar office if they are in the same building, by strapping both the (p) and (c) cross connections but if such offices are not in the same building, it is to be understood that a separate group of tandem trunks would extend from each office to the tandem office, and that a trunk when outgoing from the panel office would be connected by the cross connections (p) to selector bank appearances in such office and when outgoing from the crossbar office would be connected by the cross connections (c) to crossbar switch appearances in such office. The apparatus of the tandem office disclosed schematically in Fig. 3 may be of the general type disclosed in Patent No. 1,840,132, granted January 5, 1932, to T. H. Roberts, the tandem sender, however, being slightly modified as will be presently described. The interrupters 501, 502 and 503 of Fig. 5 form a part of a motor-driven charge timer 550 of the general type disclosed in Patent No. 2,112,375, granted March 29, 1938, to

E. B. Mead. The interrupters are arranged to be clutched to the shaft of the driving motor by the operation of clutch magnet 504. Interrupters 505 to 511, inclusive, are miscellaneous power-driven interrupters on the interrupter frame of the originating office.

It will be assumed that a person at the substation 100 of the coin box line which terminates in the panel type office X, desiring a toll connection deposits a nickel in the nickel coin slot of the coin box apparatus 101, and upon removing the substation receiver from the switchhook, becomes connected by a line finder 102, over the line finder-district selector trunk 103 and the usual sender link circuit (not shown) with an idle sender 104 in the manner fully described in the Patent No. 1,862,549 hereinbefore referred to. When the calling line becomes connected with the sender the usual dial tone is transmitted from the sender to apprise the calling person that he may proceed to dial the digits of the desired line number. It will further be assumed that a number is dialed, the office code digits of which indicate that a ten cent charge is required for the initial period of conversation. In accordance with the present invention, all toll calls to be terminated in the nearby toll area, such as calls involving ten and fifteen cent initial charges, are routed over special tandem trunks to a tandem office through which they are then completed. Therefore, in response to the registration of the office code digits indicative of the fact that the call is to be extended into a ten cent zone of the exchange area, the sender 104 proceeds to control the setting of the district selector 105 and the office selector 106 to select an idle trunk extending to the tandem office. It will be assumed that the trunk disclosed in Figs. 2 to 5, inclusive, is idle and is therefore seized by the office selector 106 over the bank terminal set 107.

It will be noted that this trunk has two terminal bank appearances in the bank of office selector 106, one of which, 107, is allocated for seizure on all toll calls for which the initial charge rate is ten cents and the other of which, 108, is allocated for seizure on all toll calls for which the initial charge rate is fifteen cents. It will be obvious that if it should be desired to enable connections to be established by dial control from coin box lines to subscribers' lines terminating in more remote offices of the exchange area, other appearances of the tandem trunk in banks of selector switches could be provided, allocated, for example, to calls for which the initial charge rate might be twenty cents, twenty-five cents, etc.

When the tandem trunk is seized ground is applied over the sleeve brush 109 and sleeve terminal 110 of the trunk and thence to the sleeve terminal of all other bank appearances of the trunk and multiples thereof to mark the trunk as busy. When all dialed digits have been registered in the sender 104, a circuit is established from battery through the right winding of relay 300 and over contacts of cam 301 in the incoming end of the tandem trunk of the tandem office, over trunk conductor 302, the No. 8 back contact of relay 200, the No. 5 back contact of relay 201, through the upper winding of polarized relay 202, the No. 7 back contact of relay 203, the No. 8 back contact of relay 204, conductor 205, through the upper winding of relay 111, the No. 6 back contact of relay 112, over the tip bank terminal of terminal set 107, tip brushes of selectors 106 and 105, contacts of cam 113 at the district selector 105, thence through the windings of relays

in the sender 104, returning over contacts of cam 114, ring brushes of selectors 105 and 106, ring bank terminal of terminal set 107, the No. 2 back contact of relay 112, conductor 206, the No. 2 back contact of relay 204, the No. 1 back contact of relay 203, through the lower winding of polarized relay 202, the No. 3 back contact of relay 201, the No. 2 back contact of relay 200, trunk conductor 303, contacts of cam 304 to ground through the left winding of relay 300. Relays 111 and 300 operate in this circuit, relay 300 functioning to cause the association of a tandem sender with the incoming end of the tandem trunk and relay 111 upon operating establishing a locking circuit for itself extending from battery through the winding of relay 115, through the lower winding and contacts of relay 111, conductor 116, the No. 5 normal contacts of relay 203, conductor 117, sleeve terminal 110, brush 109 to ground in the office selector.

Relay 115 operates in this locking circuit, locks over its upper front contact to ground on conductor 116, connects the trunk conductors 205 and 206 over its middle upper and lower contacts to the tip and ring terminals of the terminal set 107 independently of the contacts of relay 112, and establishes a circuit for relay 112 which may be traced from battery through its winding, over the inner front contacts of relay 115 to ground. Relay 112 upon operating at its back contacts disconnects the multiples of all unused appearances of the trunk. These operations take place while the circuits at the tandem office are recognizing the closure, advancing the trunk and link circuits and selecting an idle sender.

Upon the seizure of the tandem sender, a pulse receiving circuit is established between the originating sender 104 and the tandem sender, schematically disclosed in the lower portion of Fig. 3, which extends as previously traced from the sender 104 to trunk conductor 302, thence over contacts of cam 305, back contact of relay 306, upper normal contacts of relay 307, upper back contact of relay 308, serially through the windings of impulse responsive relays 309, 310 and 311, lower back contact of relay 308, inner lower normal contacts of relay 307, back contact of relay 312, contacts of cam 313, trunk conductor 303 and thence as traced to the originating sender 104. In response to the closure of this circuit the originating sender proceeds to transmit codes of impulses for the purpose of transferring the called line designation digits from its registers to registers of the tandem sender. At the end of the last code impulse transmitted for the units digit series, with relay 314 operated, relay 308 operates in a circuit from battery through its winding, over the upper contact of relay 314, the lower back contact of relay 315, the back contact of relay 309 to ground. With relay 308 operated the impulse receiving circuit is prepared for the reception of the final positive impulse transmitted from the sender 104 which circuit extends as previously traced over the upper normal contacts of relay 307, thence over the upper front contact of relay 308, through the winding of the negatively polarized impulse responsive relay 309, over the inner lower front contact of relay 308 and thence as previously traced to the originating sender. Relay 308 at its upper back contact removes the shunt from resistance 316 and bridges this resistance across the impulse receiving circuit in parallel with the winding of relay 309. The winding of relay 309 is now connected reversely into the impulse re-

ceiving circuit whereby it is responsive to the receipt of the final heavy positive impulse and establishes a circuit from ground over its front contact, over the upper normal contacts of relay 315, through the winding of relay 315 and resistance 317 to battery. Relay 317 upon operating locks over its inner upper alternate contacts to ground and prepares a circuit for relay 318. Upon the termination of the final heavy positive impulse when relay 309 releases, relay 318 energizes in a circuit from battery through resistance 319, the winding of relay 318, the inner upper alternate contacts of relay 315 to ground. With relays 315 and 318 now both operated a circuit is established for transfer relay 307 extending from battery through its winding over the lower front contact of relay 308, the inner upper front contact of relay 314, the upper contacts of relays 315 and 318 to ground. With relay 307 operated, the circuit previously established by the operation of relay 314 for relay 320 is opened at the lower back contact of relay 307, relay 307 is locked over its lower front contact to ground at the lower front contact of relay 314, and the circuit extending back to the originating sender is transferred from the winding of relay 309 to the windings of relays 321 and 322, trunk conductor 302 being now extended over the contacts of cam 305, the back contact of relay 306, the upper alternate contacts of relay 307, over the lower normal contacts of relay 320 to battery through the winding of relay 321 and trunk conductor 303 being now extended over contacts of cam 313, the back contact of relay 312, the inner lower alternate contacts of relay 307, the upper normal contacts of relay 320, to ground through the winding of relay 322.

At the outgoing end of the tandem trunk polarized relay 202 operated its armature against its left contact in response to the final heavy positive impulse, in turn causing the operation of relay 207 in a circuit from battery through its winding and the left contact of relay 202, conductor 208 to ground at the No. 3 contact of relay 112. Relay 207 upon operating locks in a circuit from battery through its winding over its upper contact and over the No. 1 back contact of relay 200 to ground on conductor 208. At the end of the heavy positive impulse, polarized relay 202 operates its armature against its right contact thereby opening the operating circuit of relay 207 and with relay 207 locked operated, establishes a circuit from battery through the winding of relay 203, over the inner lower front contact of relay 207 and the right contact of relay 202 to ground on conductor 208. Relay 207 also connects ground over the No. 2 back contact of relay 203 and its lower front contact to peg count register conductor 209 and at its back contact opens the timed release circuit. Relay 203 upon operating locks over its No. 4 contacts to ground on conductor 208; opens the peg count register circuit at its No. 2 back contact; at its No. 5 alternate contacts establishes a new holding circuit for relay 115 extending from conductor 116 over such contacts and conductor 210 to ground over the No. 3 back contact of relay 400; establishes an operating circuit for relay 201 extending from battery through its winding, over the No. 6 contacts of relay 203, the No. 7 back contact of relay 200, conductor 211, the inner upper back contact of relay 500, conductor 212 to ground over the inner lower normal contacts of relay 400; connects ground over its No. 2 front contact and conductor 117 to the sleeve terminals of the

trunk in office selectors of the panel office; connects ground over its No. 3 contacts and conductor 118 to sleeve terminals in the office switches of the crossbar office in cases where the trunk is allocated to a crossbar office; at its Nos. 1 and 7 back contacts opens the circuit previously traced through the windings of polarized relay 202; extends trunk conductor 205 over the No. 8 back contact of relay 204, the No. 7 front contact of relay 203, the No. 6 back contact of relay 204 to ground through the lower winding of relay 213 and extends trunk conductor 206 over the No. 2 back contact of relay 204, the No. 1 front contact of relay 203, and the No. 1 back contact of relay 204 to battery through the upper winding of relay 213. Relay 201 upon operating disconnects the windings of polarized relay 202 from the trunk conductors 302 and 303 at its Nos. 3 and 5 back contacts, bridges at its No. 6 contacts the contacts of relay 500 included in its operating circuit; at its No. 5 front contact connects ground over the No. 8 back contact of relay 200 and thence over the circuit traced to battery through the winding of relay 321 at the tandem sender, thereby causing the operation of relay 321 followed by the operation of relay 323, and connects ground over its No. 4 contacts, conductor 214, the No. 4 back contact of relay 401, conductor 402, to the armature of interrupter 507 which upon making its left contact completes the circuit of relay 512 over conductor 513, the No. 3 back contact of relay 200, conductor 215 to battery through the winding of relay 512. Relay 512 operates in this circuit to start a timing cycle to be later described.

The operation of relay 323 at the tandem sender signals the sender that timing thereat must be suspended since there will be some delay before the "A" operator answers and checks the deposit of the required coins in the coin box of the calling line. Relay 323 closes a circuit from ground over its upper front contact and the upper back contact of relay 324 to battery through the winding of relay 325. Relay 325 upon operating causes the operation of relay 326 over an obvious circuit, relay 326 upon operating, locking under the control of relay 327 over its lower front contact and the back contact of relay 327 and closing an obvious circuit for relay 328. With relay 328 operated or unoperated, ground is connected over its contacts, the lower normal contacts of relay 329 and the back contact of relay 325 to the back contact of timing relay 330 to start the operation of timing relays 330 to 335 to time out the tandem sender but since relay 325 has been operated this timing start circuit is not effective and the timing out of the sender is therefore delayed.

When the originating sender has completed the transmission of the final heavy positive impulse, it advances the sequence switch of the district selector 105 into the trunk closure position and the originating sender then becomes disconnected from the line finder-district trunk 103 and is restored to normal. Relay 213 now operates in a circuit which may be traced from battery through its upper winding, the No. 1 back contact of relay 204, the No. 1 front contact of relay 203, the No. 2 back contact of relay 204, conductor 206, the middle lower front contact of relay 115, ring terminals and brushes of selectors 106 and 105, contacts of cams 114 and 119, ring brush of the line finder 102, thence over the calling line loop over the tip brush of line finder 102, contacts of cams 120 and 113,

tip brushes and terminals of selectors 105 and 106, middle upper front contact of relay 115, conductor 205, the No. 8 back contact of relay 204, the No. 7 front contact of relay 203, the No. 6 back contact of relay 204 to ground through the winding of relay 213. Relay 213 upon operating over this circuit establishes a circuit from ground over its lower contacts, conductor 216, the No. 5 back contact of relay 400 to battery through the winding of slow-to-release relay 403 and at its upper contacts prepares the circuit of relay 217. Relay 403 upon operating locks in a circuit extending from battery through its winding over the No. 5 back contact of relay 400, the upper front contact of relay 403, the No. 5 normal contacts of relay 401, conductor 404, to ground at the No. 7 back contact of relay 204 and at its inner upper front contact connects ground to conductor 405 and through the winding of relay 401 to battery. Relay 401 now operates, locking over its No. 5 alternate contacts and conductor 404 to ground at the No. 7 back contact of relay 204; opens at its No. 5 normal contacts the locking circuit for relay 403 just traced; completes the circuit of relay 217 which may be traced from battery through its winding over the upper contacts of relay 213, conductor 218, the No. 2 back contact of relay 406, No. 1 front contact of relay 401 to ground at the back contact of relay 407; opens at its No. 4 back contact the previously traced circuit for relay 512 which thereupon releases and at its No. 2 contacts connects the sleeve of answering jacks 219 and 220 over the No. 1 contacts of relay 201, conductor 221, No. 2 contacts of relay 401 to ground through the winding of relay 407. The circuit to the sleeves of the jacks is not closed until this time in order to prevent the operator from interfering with the call should she inadvertently connect to the trunk.

Relay 217 upon operating with relay 115 operated to indicate a ten cent toll call, establishes a circuit for the lamp 224 which may be traced from battery over the contacts of relay 217, conductor 222, lower contacts of relay 115, conductor 223, through lamp 224 to ground thereby lighting the lamp which is adjacent to jack 219 as a signal to the "A" operator that a call has been established over the trunk to which the lamp and jack appertain requiring a toll charge of ten cents. Had the calling person dialed a called line number for which a toll charge of fifteen cents was required, the office selector 106 would have been set to seize the trunk over the terminal set 108 thereby causing the operation of relays 121 and 125 in the same manner as relays 111 and 115 were operated. The circuits would then have functioned in the manner previously described except that upon the operation of relay 217 a circuit would have been established from battery over its contacts, conductor 222, the lower contacts of relay 125, conductor 225, to ground through the lamp 226, associated with jack 220 thereby lighting such lamp to indicate that the call has been established requiring a toll charge of fifteen cents. In order that the operator may more readily determine the amount of charge required the lamps 224 and 226 may have distinctive caps, the cap of lamp 224, for example, being red for the ten cent rate and the cap of lamp 226 being green for the fifteen cent rate.

Initial response of an operator

In response to the lighted lamp 224, an op-

erator at the "A" switchboard inserts the answering plug of an idle cord circuit, such as the cord circuit schematically illustrated at 227, into the jack 219 associated with the lamp 224, whereupon the circuit of relay 407 previously traced is completed. Relay 407 upon operating, at its inner upper contact establishes the circuit of relay 408 which operates, and opens at its back contact the previously traced circuit of relay 217 which now releases and extinguishes the lamp 224. Relay 228 is also operated upon the connection of a cord circuit to the jack 219 in a circuit which may be traced in part over the tips of the cord plug and jack 219, the No. 7 back contact of relay 229, the winding of relay 228, the No. 2 back contact of relay 229 and the rings of jack 219 and the cord plug. Relay 408 upon operating connects a source of tone current associated with conductor 409 over its No. 8 contacts, conductor 410, the No. 7 back contact of relay 229, tips of jack 219 and cord plug to the operator's cord circuit to warn the operator against starting conversation with the calling person until the connection between the calling line and the operator's position has been cut through; connects the winding of relay 407 over its No. 1 contacts and conductor 411 directly to the sleeve of jack 219 and establishes a circuit for relay 412 which may be traced from battery through its winding, over conductor 413, the No. 6 back contact of relay 229, contacts of relay 228, conductor 414 to ground over its No. 6 contacts.

Relay 412 now operates, locks in a circuit extending from battery through its winding, over conductor 413, the No. 6 back contact of relay 229, conductor 415, its No. 4 contacts to ground over the No. 6 contacts of relay 408; at its No. 2 back contact removes ground from conductor 416 extending to the line discharge network comprising resistances 230, 231 and condenser 232; at its No. 3 contacts connects resistances 514 and 515 across the calling line in bridge of the windings of relay 213 in a circuit which may be traced from battery through the upper winding of relay 213, the No. 1 back contact of relay 204, the No. 3 back contact of relay 229, conductor 233, the No. 6 back contact of relay 417, the No. 2 back contact of relay 418, the No. 3 contacts of relay 412, conductor 419, serially through resistances 514 and 515, conductor 420, the No. 6 back contact of relay 204 to ground through the lower winding of relay 213, and connects ground over its No. 5 contacts and conductor 421 to the fixed contact of interrupter 505. As soon thereafter as the interrupter cam causes the closure of its contacts, a circuit is completed from ground connected to conductor 421, thence over conductor 422, over the inner lower normal contacts and through the winding of counting relay 423 and resistance 425 to battery and through the winding of counting relay 424 and resistance 426 to battery. Relay 423 now operates but the winding of relay 424 being shunted over its own No. 7 back contact does not operate so long as the contacts of interrupter 505 are closed. Relay 423 upon operating locks over its inner lower alternate contacts to ground over the No. 5 contacts of relay 412. Upon the next opening of the contacts of interrupter 505 the initial operating circuit of relay 423 is opened and relay 424 now operates in a circuit from battery through resistance 426, through its winding, over the inner lower alternate contacts of relay 423 to ground over the No. 5 contacts of relay 412. With relay 424 now op-

erated, a shunt is established from conductor 419 over the No. 1 contacts of relay 424, and conductor 432 around resistance 515 thereby reducing the shunt across the calling line to a value of 50 ohms. With relays 423 and 424 both operated, the circuit of relay 500 is established from battery through its winding over conductor 516, the No. 3 contacts of relay 424, the lower contacts of relay 423 to ground at the No. 2 back contact of relay 417. Relay 500 upon operating shunts resistance 514 over its upper contacts thereby reducing the resistance of the shunt across the calling line to zero.

Upon the next closure of the contacts associated with interrupter cam 505 ground is connected from conductor 421 over such contacts, conductor 422, the No. 7 front contact of relay 424 to a point between the winding of relay 423 and resistance 425, whereupon the winding of relay 423 becomes shunted and relay 423 releases. The circuit of relay 500 is now opened at the lower contacts of relay 423 and relay 500 releases. With relay 423 released and relay 424 still operated, a circuit is established from battery through the winding of relay 204, over conductor 234, the inner upper back contact of relay 423, the No. 6 contacts of relay 424 to ground applied to conductor 427 over the lower contacts of relay 407. Relay 204 upon operating locks over its No. 5 contacts to ground applied to conductor 427 over the lower contacts of relay 407; disconnects the windings of relay 213 from the calling line at its Nos. 1 and 6 back contacts while the line is still short-circuited; establishes a holding circuit for relay 403 extending from battery through its winding, over the No. 5 back contact of relay 400, the No. 3 contacts of relay 401, conductor 428 to ground at the No. 7 front contact of relay 204; transfers the tip and ring trunk conductors 205 and 206 at its Nos. 2 and 8 contacts from contacts of relay 203 to contacts of relay 229 in preparation for the return of the initially deposited coin at the coin box 101 of the calling line and establishes the operating circuit for counting relay 418 which may be traced from battery through resistance 429, the winding and the No. 5 normal contacts of relay 418, the upper back contact of relay 423, conductor 235, the No. 3 contacts of relay 204, conductor 236, the No. 4 contacts of relay 424 to ground at the No. 2 front contact of relay 412. The operating circuit for counting relay 417 is also prepared at this time from ground, thence as traced over the No. 5 normal contacts of relay 418 through the winding of relay 417 and resistance 430 to battery but the winding of relay 417 is shunted at this time over its own No. 7 back contact so long as relay 424 remains operated and relay 417 does not therefore operate. Relay 418 upon operating now locks over a circuit from battery through resistance 429, its winding and No. 5 alternate contacts, conductor 235 and thence to ground as traced.

Return of initially deposited coin

With relay 418 operated coin return battery is connected from the source 517, over the No. 9 back contact of relay 518, conductor 519, lower contacts of relay 403, No. 1 back contact of relay 406, No. 1 back contact of relay 417, No. 4 contacts of relay 418, conductor 431, over the Nos. 1 and 8 back contacts of relay 229 and the Nos. 2 and 8 front contacts of relay 204, thence as traced over the tip and ring conductors of the established connection through the magnet of coin box 101 to ground over contacts closed thereat by the

deposited coin. The coin box magnet is now energized in such a manner as to deposit the coin in the return chute where it may be recovered by the calling person. Upon the second opening of the contacts associated with interrupter cam 505, the holding circuit for counting relay 424 extending from ground on conductor 421, over the contacts of interrupter 505, conductor 422, the inner lower normal contacts of relay 423, through the winding of relay 424 and resistance 426 to battery is opened and relay 424 releases. With relay 424 released, the shunt of the winding of relay 417 is removed and relay 417 operates over a circuit from battery through resistance 430 and its winding, over the No. 5 alternate contacts of relay 418, conductor 235, the No. 3 contacts of relay 204, conductor 236, the No. 7 contacts of relay 418, to ground at the No. 2 front contact of relay 412. On the third closure of the contacts of interrupter 505 the previously traced circuit for relay 423 is established whereupon it reoperates but relay 424 being shunted over its own No. 7 back contact does not operate at this time. With relay 417 now operated the circuit over which coin return current was applied to the coin box 101 is opened at the No. 1 back contact of relay 417 and the capacity discharge of the calling line is established over the tip and ring conductors of the calling line extended through the operation of relay 204 to the Nos. 1 and 8 back contacts of relay 229 and thence through resistances 230 and 231 and condenser 232 to ground.

Upon the third opening of the contacts of interrupter 505, the shunt of the winding of counting relay 424 is opened and relay 424 operates over the previously traced circuit. Upon the fourth closure of the contacts of interrupter 505, relay 423 is shunted down in the manner previously described and a shunt of the winding of relay 418 is thereupon established from a point between its winding and resistance 429, over the No. 7 front contact of relay 417, the upper back contact of relay 423, conductor 235, the No. 3 contacts of relay 204, conductor 236, the No. 4 contacts of relay 424, to ground at the No. 2 front contact of relay 412. A circuit is now established from battery through the winding of relay 406 over conductor 433, the No. 6 back contact of relay 200, conductor 237, the No. 3 back contact of relay 418, the No. 8 contacts of relay 417 to ground over the No. 6 contacts of relay 401 whereupon relay 406 operates, locks over its No. 5 contacts to ground over the No. 6 contacts of relay 401 and establishes a circuit from battery through the winding of relay 229, over conductor 238, the No. 4 contacts of relay 406, the No. 4 contacts of relay 417, the upper contacts of relay 407, to ground at the No. 8 back contact of relay 400. Relay 229 upon operating locks over its No. 5 contacts, conductor 239 to ground at the inner lower front contact of relay 407; disconnects the calling line discharge circuit at its Nos. 1 and 8 back contacts; opens the circuit over which relay 228 was energized at its No. 2 and No. 7 back contacts; opens at its No. 7 back contact the circuit over which the tone current from the tone source 409 was applied to the cord circuit; connects the tip conductor of the calling line as traced over the No. 8 front contact of relay 204, thence over its No. 8 and No. 7 front contacts, conductor 240 and the tips of jack 219 and the cord circuit plug to the tip conductor of the cord circuit and connects the ring conductor of the calling line as traced over the No. 2 front contact of relay 204,

thence over its Nos. 1 and 2 front contacts, conductor 241 and the rings of jack 220 and the cord circuit plug to the ring conductor of the cord circuit.

Upon the fourth opening of the contacts of interrupter 505 the holding circuit of counting relay 424 is opened and relay 424 now releases in turn opening the holding circuit of relay 417 at its No. 4 contacts. With relay 424 released and relay 229 operated, relay 412 now releases and establishes a discharge path for condenser 232 through the 1600 ohm resistance 231, over conductor 416 to ground at the No. 2 back contact of relay 412.

Checking the deposit of coins requested for initial period

With relay 229 operated the operator may now talk with the calling person and request him to deposit the amount indicated by the lamp 224 which was previously lighted, or ten cents, to cover the initial five-minute period of the conversation. Upon hearing the tone indicative of the deposit of the requested amount the operator disconnects her cord circuit from the jack 219 thereby releasing relay 407. The approximate time which has elapsed from the time the operator answered the call to operate relay 407 and the operation of relay 229 to connect her headset with the calling station is between 1.2 and 1.7 seconds. When relay 407 releases it in turn releases relays 204, 229 and 408. Relay 204 upon releasing again connects the windings of relay 213 to the calling line and restores supervision to the tandem trunk and relay 408 upon releasing establishes the circuit of relay 200 which may be traced from battery through its winding over conductor 242, the No. 8 contacts of relay 406, the No. 7 back contact of relay 408, conductor 211, the inner upper back contact of relay 500, conductor 212 to ground at the No. 3 normal contacts of relay 400. Relay 200 upon operating locks over conductor 242, the No. 8 contacts of relay 406, conductor 243, its own No. 5 contacts to ground on conductor 212; opens the circuit of relay 201 at its No. 7 back contact whereupon relay 201 releases and over its Nos. 2 and 8 front contacts completes a talking circuit between the calling line and outgoing conductors 302 and 303 of the tandem trunk and bridges the winding of polarized supervisory relay 244 across such outgoing trunk conductors. Relay 202 upon releasing opens at its No. 1 contacts the connection to the sleeves of trunk jacks 219 and 220 to prevent interference with the call should the operator plug into one of such jacks in error.

Completion of the desired connection

With relay 200 operated a circuit is established from battery through the winding of relay 321 at the tandem sender, over the lower normal contacts of relay 320, the upper alternate contacts of relay 307, the back contact of relay 306, contacts of cam 305, trunk conductor 302, the No. 8 front contact of relay 200, the winding of polarized relay 244, the No. 2 front contact of relay 200, trunk conductor 303, contacts of cam 313, the back contact of relay 312, the inner lower alternate contacts of relay 307, the upper normal contacts of relay 320 to ground through the winding of relay 322 at the tandem sender. The current flowing over this circuit through the winding of polarized supervisory relay 244 is in such a direction as to operate its armature against its right contact. Relays 321 and 322 at the

tandem sender are now both operated in turn operating relays 323 and 324. With relay 324 operated the circuit of relay 325 is opened at its back contact and relay 325 releases to make the start circuit for timing out the tandem sender operative to function in the usual manner. A circuit is also established from ground over the lower front contacts of relays 323 and 324 through the winding of relay 327 to battery, whereupon relay 327 operates, locks in a circuit over its lower contacts, the inner upper contacts of relay 326 and the upper front contacts of relays 324 and 323 to ground. Relay 336 is also operated in a circuit from battery through its winding over the upper front contacts of relays 323 and 324 to ground and upon operating locks over its lower front contact, the lower front contact of relay 327 to ground over the lower contacts of relay 327 and the lower contacts of relay 324 and relay 323. Relay 327 upon operating opens the locking circuit of relay 326 which thereupon releases in turn opening the locking circuit of relay 327 but relay 327 is now held operated under the control of relays 323 and 324 and relay 336 over a locking circuit extending over its lower front contacts, the lower front contacts of relay 336 to ground over the upper front contacts of relays 323 and 324. With relay 327 operated the fundamental circuit is established over its upper contacts through the winding of trunk test relay 337, contacts of cams 338, 339 and 347 of the sender and contacts of cams 340 and 341 in the tandem district selector. The tandem sender now proceeds to complete the desired connection in accordance with the digital information registered therein in the usual manner. When the connection is completed the tandem sender is dismissed and the sequence switch of the tandem district selector is advanced to the trunk closure position in which position a circuit is established from battery through the left winding of relay 342, the upper back contact of relay 343, the upper left winding of repeating coil 344, contacts of cam 305, trunk conductor 302, the No. 8 front contact of relay 200, the winding of relay 244, the No. 2 front contact of relay 200, conductor 303, contacts of cam 313, the lower left winding of repeating coil 344, the lower back contact of relay 343 to ground through the right winding of relay 342. The direction of the current flowing is still in such a direction as to hold the armature of relay 244 against its right contact.

Response of the called subscriber

When the called subscriber answers, a circuit is completed which may be traced in part over the contacts of cam 341, through the upper right winding of repeating coil 344, winding of supervisory relay 345, contacts of cam 346, the lower right winding of repeating coil 344 and the upper contacts of cam 346 to cause the operation of relay 345 followed by the operation of reversing relay 343. Relay 343 upon operating reverses the connections of battery and ground through the windings of relay 342 to the trunk conductors 302 and 303 whereby current now flows in such a direction through the winding of polarized relay 244 to cause the movement of its armature into engagement with its left contact. As soon thereafter as interrupter cam 508 closes its left contact a circuit is established from ground over the No. 4 contacts of relay 200, the left contact of relay 244, conductor 245, left contact of interrupter 508, conductor 520 to battery through the winding of relay 434 which thereupon operates

and locks over its inner upper contacts to ground applied to conductor 245 by relay 244. As soon thereafter as interrupter 508 closes its right contact relay 434 establishes a circuit for relay 518 which may be traced from battery through its winding, over conductor 521, the No. 5 back contact of relay 435, conductor 522, contacts closed by cam 501 of the charge timer 550, which timer is in its normal position, conductor 523, the No. 4 back contact of relay 435, the lower front contact of relay 434, conductor 524, over the right contact of cam 508 to ground on conductor 245. Relay 518 upon operating locks in a circuit extending from battery through its winding, over conductor 521, the No. 5 back contact of relay 435, conductor 522, the No. 8 contacts of relay 518, conductor 525, the No. 5 back contact of relay 417 to ground over the No. 6 contacts of relay 406; connects ground over its No. 4 contacts to conductor 405 to hold relay 401 operated; establishes an operating circuit for relay 512 which may be traced from battery through its winding, over conductor 215, the No. 3 front contact of relay 200 and conductor 246 to ground over the No. 6 contacts of relay 518, and starts the charge timer 550 for measuring the initial period for conversation by operating clutch magnet 504. The circuit of magnet 504 may be traced from battery through its winding, over conductor 526, the No. 6 back contact of relay 435, conductor 527, the No. 3 contacts of relay 518 to ground at the No. 1 back contact of relay 528.

The energization of magnet 504 causes a gear train to engage with a shaft driven by a telechron motor. Four and one half minutes later a circuit is established for relay 412 which may be traced from battery through its winding over conductor 413, the No. 6 back contact of relay 229, conductor 415, the contacts closed by timer cam 502, to ground over the No. 2 contacts of relay 518. Relay 412 upon operating connects ground to one contact controlled by the interrupter cam 505, connects the two 50-ohm resistances 514 and 515 across the calling line and removes ground applied over conductor 416 from the line discharge network comprising resistances 230 and 231 and condenser 232 in a manner described in connection with its previous operation. Under the control of interrupter 505, counting relay 423 is operated upon the first closure of the interrupter contacts and prepares the operating circuit of counting relay 424 which thereafter operates upon the following opening of the interrupter contacts. With relays 423 and 424 both operated resistance 515 is short-circuited thus reducing the resistance bridged across the calling line to 50 ohms and relay 500 is operated to shunt resistance 514 thus further reducing the bridged resistance to zero. The application and reduction of the shunt across the calling line is for the purpose of diverting the current from the line prior to the connection of coin control battery thereto in order to prevent disturbances from reaching the called subscriber through the tandem and terminating office equipment. Upon the second closure of the contacts of interrupter 505, relay 423 is released and relay 424 is locked in its operated condition. The operating circuit of relay 500 is now opened and the operating circuit of relay 204 is closed to disconnect the windings of relay 213 from the calling line while it is still short-circuited; to lock itself operated over conductor 427 and the No. 6 contacts of relay 412, under the control of relay 435; to transfer trunk conductors 205 and 206 in preparation for coin

collection and to establish the operating circuit of counting relay 418 which thereupon operates. These functions are all performed in the manner previously described.

Collection of coins deposited for initial period

With relay 418 operated, coin collecting battery is connected from the source 529 over the No. 5 back contact of relay 528, conductor 530, the No. 3 back contact of relay 435, conductor 536, the No. 5 contacts of relay 518, conductor 531, the No. 1 back contact of counting relay 417, the No. 4 contacts of relay 418, conductor 431, over the Nos. 1 and 8 back contacts of relay 229 and the Nos. 2 and 8 front contacts of relay 204, thence over the tip and ring conductors of the established connection through the magnet of coin box 101 to ground over contacts closed thereat by the deposited coin or coins. The coin box magnet is now energized in such a manner as to transfer the previously deposited coin or coins to the coin box till. Upon the second opening of the contacts associated with cam 505, relay 424 is released and relay 417 is operated in the manner previously described to open the circuit over which coin collecting current was applied to the coin box 101. Upon the third closure of the contacts associated with cam 505, relay 423 again operates and with relay 417 operated the capacity charge of the calling line is dissipated over the tip and ring conductors of the line extended through the operation of relay 204 to the Nos. 1 and 8 back contacts of relay 229 and thence through resistances 230 and 231 and condenser 232 to ground.

Upon the third opening of the contacts of interrupter 505, relay 424 operates and upon the fourth closure of the interrupter contacts relay 423 releases in turn releasing relay 418 in the manner previously described. A circuit is now established for relay 435 which may be traced from battery through its winding over conductor 437, the No. 6 front contact of relay 200, conductor 237, the No. 3 back contact of relay 418, the No. 8 contacts of relay 417 to ground over the No. 6 contacts of relay 401. Relay 435 upon operating locks in a circuit traced through its winding to conductor 237, thence over its No. 2 contacts, the No. 5 back contact of relay 408 to ground over the No. 6 contacts of relay 401, opens the locking circuit of relay 204 at its No. 1 back contact whereupon relay 204 releases to reconnect the windings of relay 213 to the calling line and at its No. 5 back contact opens the locking circuit of relay 518 which thereupon releases. Upon the fourth opening of the contacts of interrupter 505, relay 424 releases followed by the release of relays 417 and 412 as previously described. Relay 412 upon releasing discharges condenser 232 through the 1600-ohm resistance 231. Relay 204 has been operated for an interval of 1.2 to 1.7 seconds during the collection of the deposited coin or coins and no tone current has been transmitted to the calling line when the coins are collected to avoid encouraging the calling person to deposit further coins.

The charge timer 550 continues its operation until the normal contacts associated with its cam 501 close five minutes after relay 518 operated at which time a circuit is established from battery through the winding of overtime relay 528, conductor 532, the No. 4 front contact of relay 435, conductor 523, closed contacts associated with cam 501, conductor 522, the No. 5 front contact of relay 435, conductor 245, the left contact of relay 244 to ground over the No. 4 con-

tacts of relay 200 if the conversation still continues and relay 244 has therefore remained operated. Relay 528 upon operating locks over its No. 3 contacts and conductor 533 to ground over the No. 6 contacts of relay 401; establishes a circuit from battery through the winding of relay 217, over the upper contacts of relay 213, conductor 218, the No. 4 contacts of relay 528, over contacts associated with interrupter cam 506, conductor 534, the No. 1 contacts of relay 401 to ground at the back contact of relay 407 whereby relay 217 is intermittently operated; and establishes a circuit from the sleeves of jacks 219 and 220 over conductor 411, the No. 2 contacts of relay 528, conductor 535, the No. 2 contacts of relay 401 to ground through the winding of relay 407. Relay 217 upon operating and releasing intermittently, flashes the lamp 224 over the previously traced circuit as a signal to the operator that the overtime period on the established connection has been reached.

Overtime response of an operator

The operator answers the flashing lamp by inserting the answering plug of one of her cord circuits into the jack 219 associated with such flashing lamp whereupon relay 407 operates followed by the operation of relay 228. Relay 407 upon operating opens the circuit of relay 217 whereby the flashing lamp 224 is extinguished and establishes the circuit of relay 408 which thereupon operates to connect the tone source on conductor 409 to the operator's position to warn the operator not to commence a conversation with the calling person; opens the locking circuit of relay 435 at its No. 5 back contact which relay thereupon releases; establishes a circuit for relay 412 which may be traced from battery through its winding over conductor 413, the No. 6 back contact of relay 229, contacts of relay 228, conductor 414 to ground over the No. 6 contacts of relay 408 and closes the sleeves of jack 219 and 220 directly to ground through the winding of relay 407, over its No. 1 contacts. Relay 435 upon releasing reestablishes the previously traced operating circuit for relay 518 upon the next closure of the right contact of interrupter 508 if the called subscriber has not disconnected and relay 412 upon operating locks over conductor 413, the No. 6 back contact of relay 229, conductor 415, the No. 4 contacts of relay 412 to ground over the No. 6 contacts of relay 408; connects the resistances 514 and 515 across the calling line in a circuit which may be traced from trunk conductor 205 over the No. 8 back contact of relay 204, the No. 7 front contact of relay 203, conductor 420, through resistances 514 and 515, conductor 419, the No. 3 contacts of relay 412, the No. 2 back contact of relay 418, the No. 6 back contact of relay 417, conductor 233, the No. 3 back contact of relay 229, the No. 1 front contact of relay 203 and the No. 2 back contact of relay 204 to trunk conductor 206; at its No. 2 back contact removes ground from the line discharge network comprising resistances 230 and 231 and condenser 232 and connects ground over its No. 5 contacts and conductor 421 to one of the contacts of interrupter 505. In response to subsequent closures and openings of the contacts of interrupter 505, counting relays 423 and 424 are operated and released in the manner previously described.

Under the control of interrupter 505 relay 423 is operated upon the first closure of the inter-

rupter contacts and prepares the operating circuit of relay 424 which thereafter operates upon the following opening of the interrupter contacts. With relays 423 and 424 both operated, resistance 515 is short-circuited thus reducing the resistance bridged across the calling line to 50 ohms and relay 500 is operated to shunt resistance 514 thus further reducing the bridged resistance to zero. Upon the second closure of the contacts of interrupter 505, relay 423 is released and relay 424 is locked in its operated condition. The operating circuit of relay 500 is now opened and the operating circuit of relay 204 is closed to disconnect the windings of relay 213 from the calling line while it is still short-circuited; to lock itself operated over its No. 5 contacts and conductor 427 to ground over the lower contacts of relay 407; to transfer trunk conductors 205 and 206 to the Nos. 8 and 1 contacts of relay 229 preparatory to establishing a talking circuit with the operator's cord circuit; to prepare the locking circuit of relay 403 and to establish the operating circuit of counting relay 418 which thereupon operates. These functions are performed in the manner previously described.

With relay 418 operated, a circuit is established from battery through the winding of relay 229 over conductor 238, the No. 4 contacts of relay 406, the No. 1 contacts of relay 418, the upper contacts of relay 407 to ground at the No. 8 back contact of relay 400. Relay 229 upon operating locks over its No. 5 contacts and conductor 239 to ground over the inner lower front contact of relay 407; discontinues the application of tone current from the source 409 to the operator's headset; opens the operating circuit of relay 412 leaving it operated under the control of relay 424 and at its Nos. 1, 2, 7 and 8 front contacts cuts through a talking connection from the calling line to the operator's cord circuit. Upon the second opening of the contacts of interrupter 505, relay 424 releases and counting relay 417 is operated in the manner previously described, whereupon relay 412 releases. With relays 412 and 424 released, relay 418 releases. The calling line is now in a similar relation to the operator's cord circuit as it would be on a connection established in the usual manner with the operator's position by dialing zero; the operator being able to talk with the calling person over the connection just traced over the front contacts of relays 204 and 229, collect or return coins by the use of the collect or return keys of her position, receive supervision and control ringing. The interval from the interruption of the conversation by the operation of relay 204 until the operator is connected is from .2 to .7 of a second. The connection between the trunk conductors 205 and 206 and the outgoing trunk conductors 302 and 303 extends over front contacts of relays 204 and 229 and the outer back contacts of splitting relay 247 and thus a three-way talking connection is effected. An appreciable transmission loss is produced while the talking key of the cord circuit is operated but with this key normal the loss is negligible.

The operator upon conversing with the calling person informs him that the initial period for conversation for which he has previously deposited coins has expired. She may then follow either of two different lines of procedure dependent upon the traffic regulations set up by the operating company, that is, she may request

the calling person to deposit the required number of coins for the overtime period if he desires to continue the conversation and make out a ticket whereby she may time the call, or she may request the calling person to signal her when he has terminated the conversation after which she will inform him as to the additional coins which he should deposit for the elapsed overtime period and she will also make out a ticket whereby she may time the call.

Should she follow the first procedure and the calling party fail to deposit the required coin or coins for the overtime period just beginning, she may insert a cord circuit plug into the operating jack 249 thereby establishing a circuit over the sleeves of the cord circuit plug and jack, over the No. 4 contacts of relay 229 to ground through the winding of relay 247 whereupon relay 247 operates; locks directly to the jack sleeve; at its back contacts opens the talking connection between the calling and called lines and at its outer front contacts establishes a talking connection from her cord circuit plugged into the splitting jack 249 to the talking connection extending to the called line. The operator can now talk to either the calling person or the called subscriber at will but the calling person and the called subscriber cannot talk to each other. If the calling person deposited the required coins the operator may make out a ticket, time the call and at the expiration of one or more overtime periods request the calling person to deposit additional coins for the additional overtime period or periods if he desires to continue the conversation. The provision of the splitting jacks enables the operator to break in open the conversation at any time during the overtime period. Ordinarily, she would not do so on calls for which the charge rate is more than fifteen cents because on such higher rate calls the overtime periods might be as short as one or two minutes and it would not be desirable from a service standpoint to interrupt the conversation frequently.

Should the operator follow the second procedure, she will make out a ticket when she has ascertained that the calling person desires to continue the conversation and will time the call. When she receives a signal from the calling person that he has terminated the conversation, she may then inform him from the elapsed time noted on the ticket as to the amount in coins he should deposit for the overtime period or periods of conversation.

It will be obvious that the circuits could with very slight modification be arranged to automatically time each overtime period and to call in the operator at the expiration of each time period to request the deposit of an additional coin or coins for the next overtime period.

Disconnection

If the calling person abandons the connection and through some trouble condition the district selector 105 or the district junctor of a crossbar office releases without waiting for the originating sender to transmit the final heavy positive impulse to operate relay 202, relay 203 will not be operated and therefore the locking circuit for relay 115 will extend as previously traced over conductor 116 and the No. 5 normal contacts of relay 203 to the sleeve conductor 117. When ground is removed from the sleeve conductor 117 at the office selector 106 upon its release following the release of the district selector 105, relay 115 releases followed by the release of relay 112

thus restoring the trunk circuit to normal. The release of apparatus at the tandem office follows in the usual manner.

If disconnection should occur as the district selector 105 goes through its trunk closure position while awaiting the response of the operator initially or between the $4\frac{1}{2}$ minute interval and the beginning of the overtime interval and before relay 518 has operated, relay 213 will release. It will be assumed that the disconnection occurs between the $4\frac{1}{2}$ minute interval and the response of the operator. When relay 213 releases, relay 403 releases and a circuit is established from battery through the winding of relay 400, the No. 8 contacts of relay 401 to ground at the back contact of relay 403. Relay 400 upon operating locks over its No. 1 contacts and conductor 438 to ground over the No. 4 contacts of relay 112; establishes a holding circuit for relay 115 which may be traced from conductor 116, over the No. 5 alternate contacts of relay 203, the No. 4 back contact of relay 204, conductor 247 to ground over its No. 8 front contact; at its No. 5 back contact opens the operating circuit of relay 403 thereby locking in the disconnect condition; at its No. 3 back contact opens the locking circuit of relay 200 which thereupon releases; and establishes the circuit of relay 500 which may be traced from battery through its winding over conductor 516 to ground over the No. 2 contacts of relay 400. Relay 200 upon releasing opens the trunk toward the tandem district selector thereby initiating the release of the connection to the called line; releases relay 244 if operated and releases relays 435 and 512. Relay 244, upon releasing, releases relay 434. With relay 500 operated, a circuit is established for operating relay 204 which may be traced from battery through the winding of relay 204 over conductor 234, the No. 4 contacts of relay 400, conductor 427 to ground over the inner upper front contact of relay 500. Relay 204, upon operating, locks directly to ground over conductor 427 and the front contacts of relay 500; opens the locking circuit of relay 401 at its No. 7 back contact; establishes a short circuit between trunk conductors 205 and 206 over its Nos. 2 and 8 front contacts and the Nos. 1 and 8 back contacts of relay 229 to block a trunk test on any new call and opens the locking circuit of relay 115 at its No. 4 back contact whereupon relay 115 releases together with relay 111. Relay 401 upon releasing opens the holding circuit of relay 406 at its No. 6 contacts whereupon relay 406 releases and relay 115 upon releasing releases relay 112 followed by the release of relays 203 and 400. Relay 203 upon releasing removes busy ground from the sleeve conductors 117 and 118 and relay 400 upon releasing releases relay 500 followed by the release of relay 204.

If a disconnection occurs before trunk closure at the district trunk 103, relays 213 and 403 operate on the trunk closure in the sender 104 and relay 403 locks in a circuit from battery through its winding, over the No. 5 back contact of relay 400, over its own upper contacts, the No. 5 normal contacts of relay 401, conductor 404 to ground over the No. 7 back contact of relay 204. When relay 401 operates following the operation of relay 403, relay 403 will release if relay 213 is no longer operated or when relay 213 releases if the trunk closure has not ended. From this point the release of the trunk proceeds as just described except that certain relays are not operated and need not therefore be released. The lamp 224 or 226 may flash at the "A" switchboard but

this is held to a minimum by controlling the circuit of relay 217 over front contacts of both relays 213 and 401.

If a disconnection occurs while awaiting the initial answer of the operator, the operation is similar to that described except that relay 201 is operated thereby holding the tandem sender from releasing. When relay 400 operates as previously described relay 201 is released instead of relay 200 and the tandem circuit then proceeds to release immediately.

If a disconnection occurs after relay 200 has operated but before the called subscriber has answered or on a busy back condition the operation is similar to that described except that relay 435 is not operated.

There are two disconnect conditions which may arise after relay 518 has operated and with no operator's cord circuit plugged into a trunk jack; one between the initial operation of relay 518 and the closure of the $4\frac{1}{2}$ minute contacts associated with cam 502 of the charge timer 550, and the other after the operator has disconnected following the start of the overtime interval. This latter condition occurs only if relay 244 has operated and the operator answers at the beginning of the overtime interval. Relay 213 releases when the calling person disconnects, or fails to operate when the operator withdraws her cord circuit plug from the trunk jack 219 or 220. Relay 403 then releases and relay 400 operates locking over its No. 1 contacts to ground over the No. 7 contacts of relay 401 and over conductor 438 to ground over the No. 4 contacts of relay 112; supplying a holding circuit for relay 115; opening the operating circuit for relay 403 to lock in the disconnect condition; releasing relay 200 and operating relay 500 in the manner previously described. Relay 200 upon releasing opens the trunk toward the tandem office, releases relay 244 if operated, and releases relay 512. With relay 244 released, relay 434 is released. Relay 500 upon operating causes the operation of relay 204 in the manner previously described whereupon the trunk conductors 205 and 206 are connected over its Nos. 2 and 8 front contacts and the Nos. 1 and 8 back contacts of relay 229 to the line discharge network comprising resistances 230 and 231 and condenser 232; locks itself under the control of relay 500 and establishes the circuit of relay 412 which may be traced from battery through its winding over conductor 413, the No. 6 back contact of relay 229, conductor 415, the No. 7 contacts of relay 518, conductor 537, the No. 3 contacts of relay 406, conductor 439, the No. 4 front contact of relay 204, conductor 247 to ground over the No. 8 front contact of relay 400. From this point the operation is practically the same as previously described in connection with the collection of the deposited coin for the initial period of conversation except that relay 204 is already operated and relay 435 does not operate. When relay 418 releases, the locking circuit of relay 518 is opened and relay 518 releases thereby releasing the charge timer 550 unless the pick-up contacts associated with cam 503 are closed; opening the circuit of relay 401 at its No. 4 contacts whereupon relay 401 releases and opening the holding circuit of relay 115 at its No. 1 contacts whereupon relays 115 and 111 release. Relay 115 upon releasing releases relay 112 and relay 401 upon releasing releases relay 406 which in turn at its No. 7 contacts removes ground from conductor 440 to release the timer if the pick-up contacts associated with cam 503 are closed. With

relay 112 released the trunk circuit releases to normal as previously described.

If disconnection occurs while a cord circuit is plugged into jack 219 or 220 the answering supervisory lamp at the cord circuit will be lighted. The operator then collects the coins remaining in the coin box or if necessary rings the calling station to obtain any money due and then withdraws the cord plug thereby releasing relay 407. Relay 407 upon releasing releases relays 204 and 229 and releases relay 408 if no cord circuit has been plugged into one of the splitting jacks 249 or 250. Relay 213 will not reoperate when relay 204 releases and the circuit will proceed to release as previously described.

Should the calling person abandon the call without replacing the receiver on the switchhook at the calling station, the operator may release the connection when she answers the initial lighting of one of the trunk lamps 224 or 226. When she can obtain no response from the calling person although the receiver is still off the switchhook, a cord circuit is momentarily inserted into one of the splitting jacks 249 or 250 thereby causing the operation of relay 247. Relay 400 is now operated at once over a circuit which may be traced from battery through the winding of relay 400 over conductor 442, the No. 2 contacts of relay 201 to ground over the inner upper contacts of relay 247 and upon operating releases relay 201 and the tandem office circuits. When the operator withdraws the cord circuit from the answering jack the circuit releases as on a regular disconnection before the operator answers except that relay 201 is already released.

Timed release

If the called subscriber answers the call long enough to cause the operation of relays 244, 434, 512 and 518 as previously described, and then disconnects while the calling line is still in the calling condition, a timing cycle of either one to two minutes or two to four minutes is started. With relays 200 and 201 operated and relay 244 released, relay 538 is operated over a circuit which may be traced from battery through its winding, over the contacts controlled by interrupter cam 511, the inner lower contacts of relay 512, conductor 539 the right contact of relay 244 to ground over the No. 4 contacts of relay 200; locks over its lower contacts to its operating circuit independent of the contacts of interrupter 511 and closes a circuit from battery through the winding of relay 540, over its upper contacts as soon as the contacts associated with interrupter cam 510 close. With relays 512 and 540 both operated a circuit is established from ground over contacts of relay 540, the middle lower contacts of relay 512, conductor 541, the lower back contact of relay 207, conductor 441, the back contacts of relay 434 to battery through the winding of relay 400. The trunk then proceeds to release in the manner previously described except that if a cord circuit has been plugged into one of the jacks 219 or 220, only the tandem office equipment is released immediately. In this case when the operator withdraws the cord plug, relay 403 is already released and relays 400, 500 and 203 are operated. It is to be noted that the interrupters 510 and 511 and relays 538 and 540 constitute a timed release control equipment common to five trunks.

Trunk closure failure

It will be recalled that at the end of the transmission of the final heavy positive impulse, relay

201 operated followed by the operation of relay 512 as soon thereafter as interrupter cam 507 closes its left contact. With relay 512 operated, if trunk closure is not completed by the time cam 507 causes the closure of its right contact, a circuit is established from ground over the No. 4 contacts of relay 201, conductor 214, the No. 4 back contact of relay 401, conductor 402, the right contact of cam 507, the lower contacts of relay 512, conductor 542 to battery through the winding of relay 400. With relay 400 operated the trunk circuit releases in the manner previously described as though a momentary trunk closure had been received.

Time alarm circuit

The time alarm circuit comprising the interrupter cam 509, relays 544 and 545, lamp 546 and key 547 is provided for each group of five trunks. Whenever either relay 400 or 412 operates with relay 408 released a timing cycle is started in order to check that the circuit can release and control coins properly. The circuit for starting the timing cycle may be traced from battery through the winding of relay 543, over conductor 548, the No. 4 back contact of relay 408, over the No. 1 front contact of relay 412 or the No. 6 front contact of relay 400, conductor 549, the upper normal contacts of relay 543, the back contact of relay 544 to ground over the back contact of relay 545. Relay 543, which is individual to the trunk, upon operating locks itself over its upper alternate contacts independent of relays 544 and 545 and establishes a circuit from ground over its inner contacts and the right contact of interrupter 509, as soon thereafter as such contact closes, to battery through the winding of relay 544. Relay 544 upon operating locks under control of relay 543, opens the initial operating circuit of relay 543 and the circuit of other similar relays to prevent the seizure of the timing circuit by other trunks and prepares an operating circuit for relay 545 which is completed over its upper contacts, the left contact of interrupter 509 to ground over the inner contact of relay 543 as soon as interrupter 509 closes its left contact. Relay 545 upon operating locks under the control of alarm release key 547, establishes an alarm circuit over its inner lower front contact, lights the alarm lamp 546 and opens a further point in the operating circuits of relay 543 and similar relays.

In some exchange areas the initial deposit of a coin to initiate the starting of a call is not required, but the completion of the connection is arrested, for example, just prior to the units selection operation of the final selector, until the calling subscriber has deposited a coin. With this mode of procedure a calling subscriber may make emergency calls to an operator even though he has no coin of the suitable denomination for deposit in the coin box. The trunk circuit of the present invention will function equally well in exchange areas of this character.

What is claimed is:

1. In a telephone system, a first office, a coin box line terminating therein, a tandem office, terminating offices, switching mechanism in said offices, control means in said tandem office, an operator's position having cord circuits in said first office, a trunk extending between said first and said tandem offices having a separate appearance in the switching mechanism of said first office and a corresponding lamp and jack appearance at said operator's position for each of a

plurality of charge rates for calls from said line to desired lines terminating in said terminating offices, means operated upon the seizure of said trunk to prepare said control means for controlling the completion of the desired connection and for lighting the lamp at said operator's position indicative of the charge rate for the desired connection, means operative following the connection of a cord circuit of said position to the jack associated with the lighted lamp for enabling the operator to request and to check the deposit of the required coin or coins, and means responsive to the disconnection of said cord circuit from said jack for signaling said control means to proceed with the control of the completion of the desired connection.

2. In a telephone system, a first office, a coin box line terminating therein, a tandem office, terminating offices, switching mechanism in said offices, control means in said tandem office, an operator's position having cord circuits in said first office, a trunk extending between said first and said tandem offices having a separate appearance in the switching mechanism of said first office and a corresponding lamp and jack appearance at said operator's position for each of a plurality of charge rates for calls from said line to desired lines terminating in said terminating offices, means operated upon the seizure of said trunk to prepare said control means for controlling the completion of the desired connection and for lighting the lamp of said operator's position indicative of the charge rate for the desired connection, means operative in response to the connection of a cord circuit of said position to the jack associated with the lighted lamp for refunding the coin initially deposited in the coin box of said calling line, means thereafter effective to enable the operator to request and to check the deposit of a coin or coins in payment for the initial period of conversation, and means responsive to the disconnection of said cord circuit from said jack for signaling said control means to proceed with the control of the completion of the desired connection.

3. In a telephone system, a first office, a coin box line terminating therein, a tandem office, terminating offices, switching mechanism in said offices, control means in said tandem office, an operator's position having cord circuits in said first office, a trunk extending between said first and said tandem offices having a separate appearance in the switching mechanism of said first office and a corresponding lamp and jack appearance at said operator's position for each of a plurality of charge rates for calls from said line to desired lines terminating in said terminating offices, means operated upon the seizure of said trunk to prepare said control means for controlling the completion of the desired connection and for lighting the lamp at said operator's position indicative of the charge rate for the desired connection, means operative in response to the connection of a cord circuit of said position to the jack associated with the lighted lamp for refunding the coin initially deposited, means effective a measured interval thereafter for discharging the capacity charge from said calling line, means effective after a further measured interval for cutting through a talking circuit from said calling line to said operator's position to enable the operator to request and to check the deposit of a coin or coins in payment for the initial period of conversation, and means responsive to the disconnection of said

cord circuit from said jack for signaling said control means to proceed with the control of the completion of the desired connection.

4. In a telephone system, a first office, a coin box line terminating therein, a tandem office, terminating offices, switching mechanism in said offices, control means in said tandem office, an operator's position having cord circuits in said first office, a trunk extending between said first and said tandem offices having a separate appearance in the switching mechanism of said first office and a corresponding lamp and jack appearance at said operator's position for each of a plurality of charge rates for calls from said line to desired lines terminating in terminating offices, means operated upon the seizure of said trunk to prepare said control means for controlling the completion of the desired connection and for lighting the lamp at said operator's position indicative of the charge rate for the desired connection, means operative following the connection of a cord circuit of said position to the jack associated with the lighted lamp for enabling the operator to request and to check the deposit of a coin or coins in payment for the initial period of conversation, means responsive to the disconnection of said cord circuit from said jack for signaling said control means to proceed with the control of the completion of the desired connection, and means operative a predetermined interval following the response of the called subscriber for causing the collection of the deposited coin or coins.

5. In a telephone system, a first office, a coin box line terminating therein, a tandem office, terminating offices, switching mechanism in said offices, control means in said tandem office, an operator's position having cord circuits in said first office, a trunk extending between said first and said tandem offices having an appearance in the switching mechanism of said first office and a lamp and jack appearance at said operator's position for each of a plurality of charge rates for calls from said line to desired lines terminating in said terminating offices, means operated upon the seizure of said trunk to prepare said control means for controlling the completion of the desired connection and for lighting the lamp at said operator's position indicative of the charge rate for the desired connection, means operative in response to the connection of a cord circuit of said position to the jack associated with the lighted lamp for refunding the coin initially deposited in the coin box of said calling line, means thereafter effective to enable the operator to request and to check the deposit of a coin or coins in payment for the initial period of conversation, means responsive to the disconnection of said cord circuit from said jack for signaling said control means to proceed with the control of the completion of the desired connection, and means operative a predetermined interval following the response of the called subscriber for causing the collection of the last deposited coin or coins.

6. In a telephone system, a first office, a coin box line terminating therein, a tandem office, terminating offices, switching mechanism in said offices, control means in said tandem office, an operator's position having cord circuits in said first office, a trunk extending between said first and said tandem offices having an appearance in the switching mechanism of said first office and a lamp and jack appearance at said operator's position for each of a plurality of charge

rates for calls from said line to desired lines terminating in said terminating offices, means operated upon the seizure of said trunk to prepare said control means for controlling the completion of the desired connection and for lighting the lamp at said operator's position indicative of the charge rate for the desired connection, means operated in response to the connection of a cord circuit of said position to the jack associated with the lighted lamp to enable the operator to request and to check the deposit of a coin or coins in payment for the initial period of conversation, means responsive to the disconnection of said cord circuit from said jack for signaling said control means to proceed with the control of the completion of the desired connection, means operative upon the response of the called subscriber to start the measurement of an initial period for conversation, means effective just prior to the termination of such period for causing the collection of the deposited coin or coins, and means operative at the end of such period for flashing the lamp previously lighted to inform an operator that said initial period has terminated.

7. In a telephone system, a first office, a coin box line terminating therein, a tandem office, terminating offices, switching mechanism in said offices, control means in said tandem office, an operator's position having cord circuits in said first office, a trunk extending between said first and said tandem offices having an appearance in the switching mechanism of said first office and a lamp and jack appearance at said operator's position for each of a plurality of charge rates for calls from said line to desired lines terminating in said terminating offices, means operated upon the seizure of said trunk to prepare said control means for controlling the completion of the desired connection and for lighting the lamp at said operator's position indicative of the charge rate for the desired connection, means operated in response to the connection of a cord circuit of said position to the jack associated with the lighted lamp to enable the operator to request and to check the deposit of a coin or coins in payment for the initial period of conversation, means responsive to the disconnection of said cord circuit from said jack for signaling said control means to proceed with the control of the completion of the desired connection, means operative upon the response of the called subscriber to start the measurement of an initial period for conversation, means effective just prior to the termination of such period for causing the collection of the deposited coin or coins, means operative at the end of such period for flashing the lamp previously lighted, and means responsive to the connection of a cord circuit to the jack associated with the flashing lamp to enable the operator to converse with said calling person, to supervise on the connection and to cause the collection or refunding of any coins subsequently deposited in payment for overtime periods of conversation.

8. In a telephone system, a first office, a coin box line terminating therein, a tandem office, terminating offices, switching mechanism in said offices, control means in said tandem office, an operator's position having cord circuits in said first office, a trunk extending between said first

and said tandem offices having an appearance in the switching mechanism of said first office and a lamp, an answering jack and a splitting jack appearance at said operator's position for each of a plurality of charge rates for calls from said line to desired lines terminating in said terminating offices, means operated upon the seizure of said trunk to prepare said control means for controlling the completion of the desired connection and for lighting the lamp at said operator's position indicative of the charge rate for the desired connection, means operated in response to the connection of a cord circuit of said position to the answering jack associated with the lighted lamp to enable the operator to request and to check the deposit of a coin or coins in payment for the initial period of conversation, means responsive to the disconnection of said cord circuit from said jack for signaling said control means to proceed with the control of the completion of the desired connection, means operative a predetermined period following the response of the called subscriber for causing the collection of the deposited coin or coins and for flashing the lamp previously lighted at the end of the initial period allowed for conversation, means responsive to the connection of a cord circuit to the answering jack associated with the flashing lamp to enable the operator to request and to check the deposit of a coin or coins for an overtime period of conversation, and means effective upon the connection of another cord circuit with the splitting jack associated with the flashing lamp to enable the operator to talk with either the calling person or the called subscriber but to prevent the calling person and called subscriber from talking with each other.

9. In a telephone system, a first office, a coin box line terminating therein, a tandem office, terminating offices, switching mechanism in said offices, control means in said tandem office, an operator's position having cord circuits in said first office, a trunk extending between said first and said tandem offices having an appearance in the switching mechanism of said first office and a lamp, answering jack and splitting jack appearance at said operator's position for each of a plurality of charge rates for calls from said line to desired lines terminating in said terminating offices, means operated upon the seizure of said trunk to prepare said control means for controlling the completion of the desired connection and for lighting the lamp at said position indicative of the charge rate for the desired connection, means operative following the connection of a cord circuit of said position to the answering jack associated with the lighted lamp for enabling the operator to request and to check the deposit of the required coin or coins, and means responsive to the connection of another cord circuit to the splitting jack associated with the lighted lamp in the event the calling person does not respond and has left the station without restoring the receiver to the switchhook for preparing the trunk and tandem office apparatus for restoration to its normal condition upon the disconnection of said cord circuits from said jacks.

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