

Feb. 6, 1934.

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1,946,228

TELEPHONE SYSTEM

Filed May 17, 1933

5 Sheets-Sheet 1

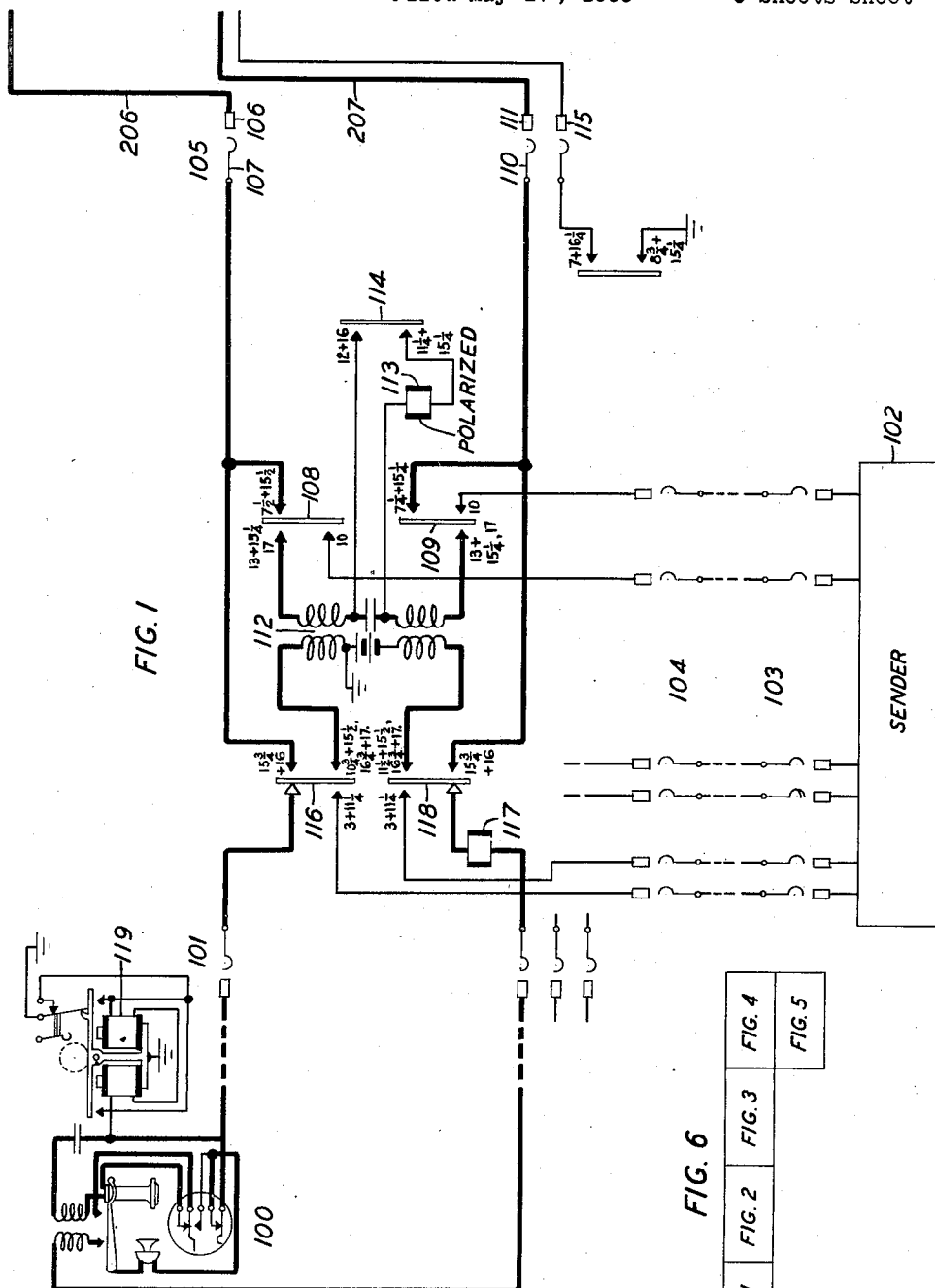


FIG. 6

FIG. 1	FIG. 2	FIG. 3	FIG. 4	FIG. 5
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5 Sheets-Sheet 2

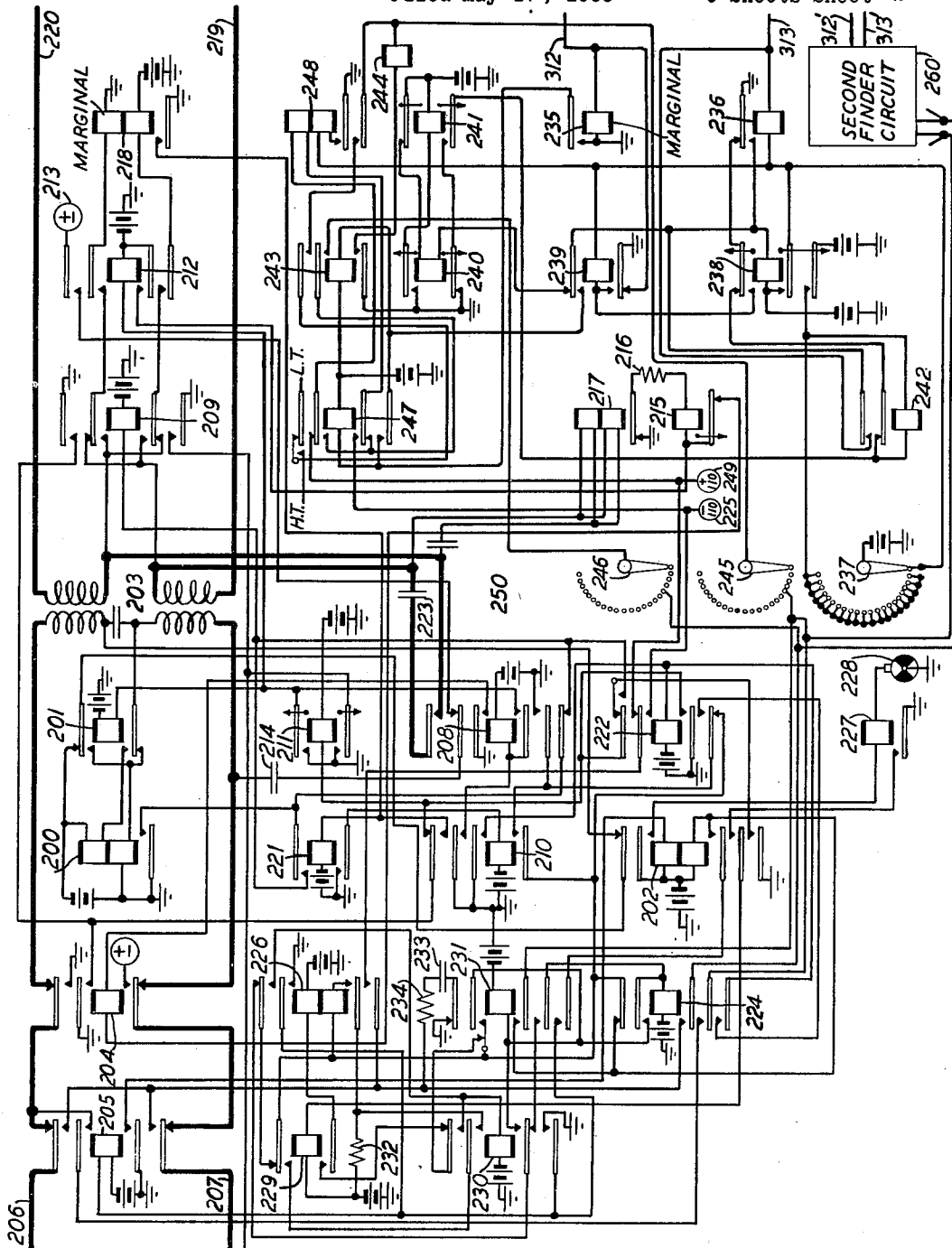


FIG. 2

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5 Sheets-Sheet 3

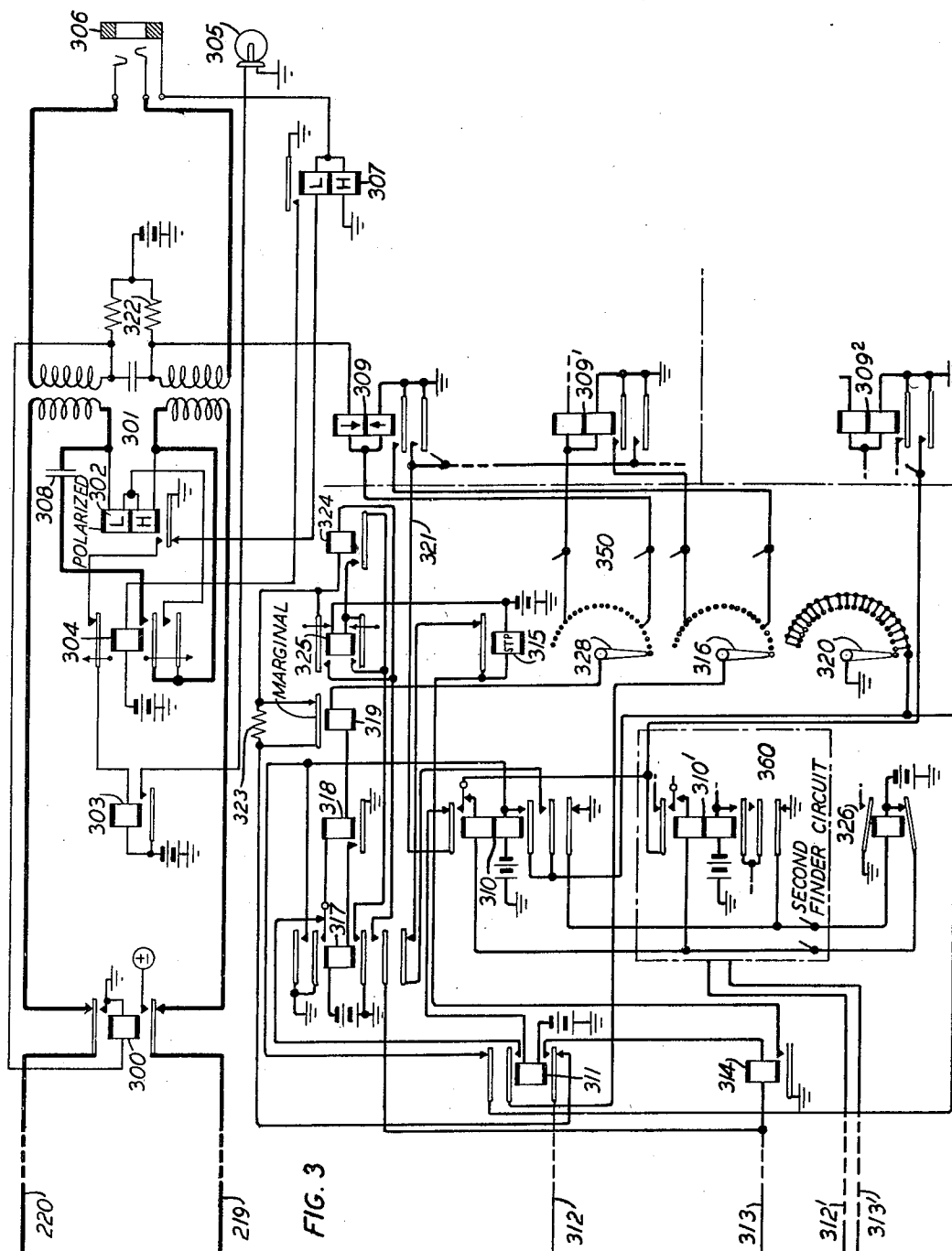


FIG. 3

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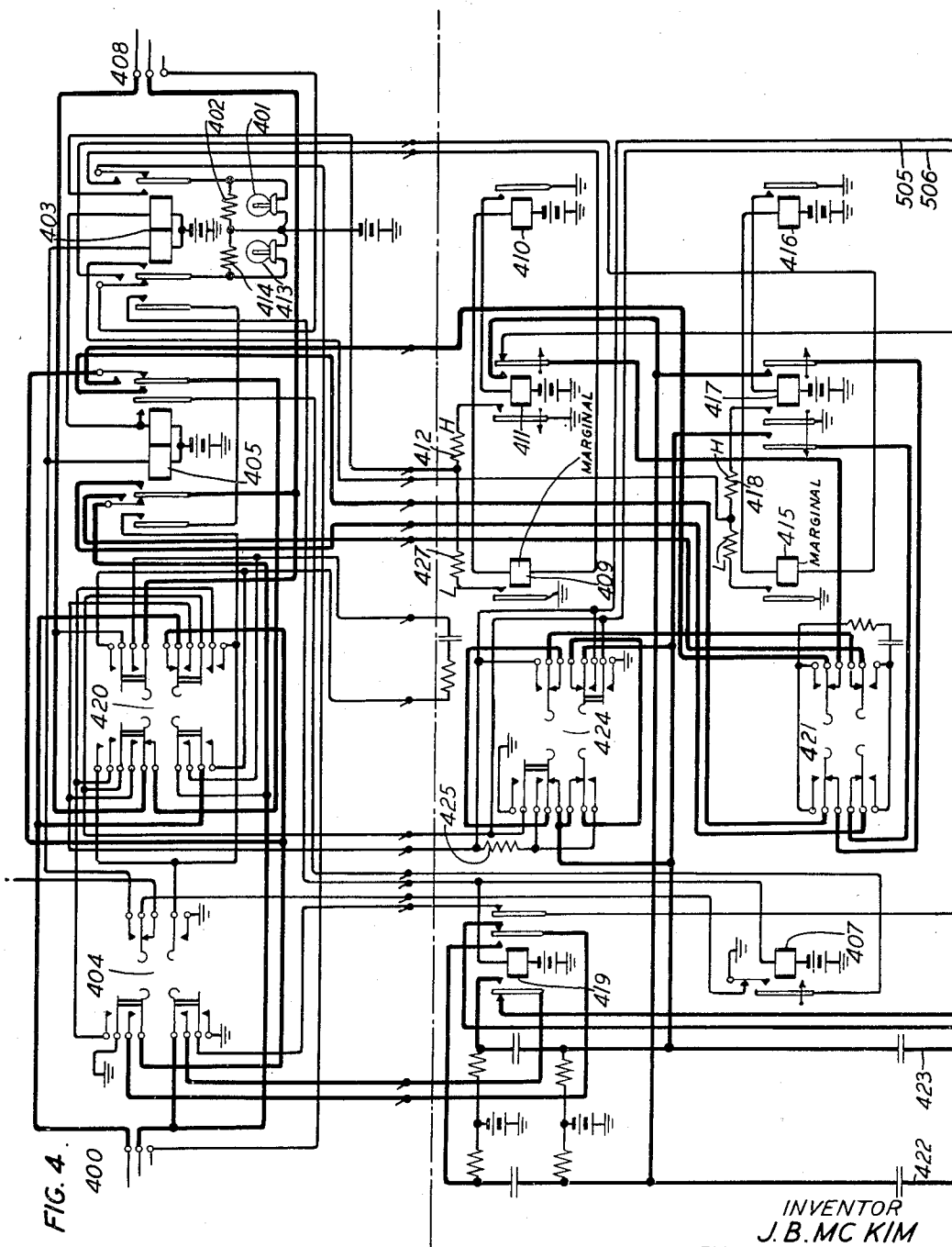


FIG. 4.

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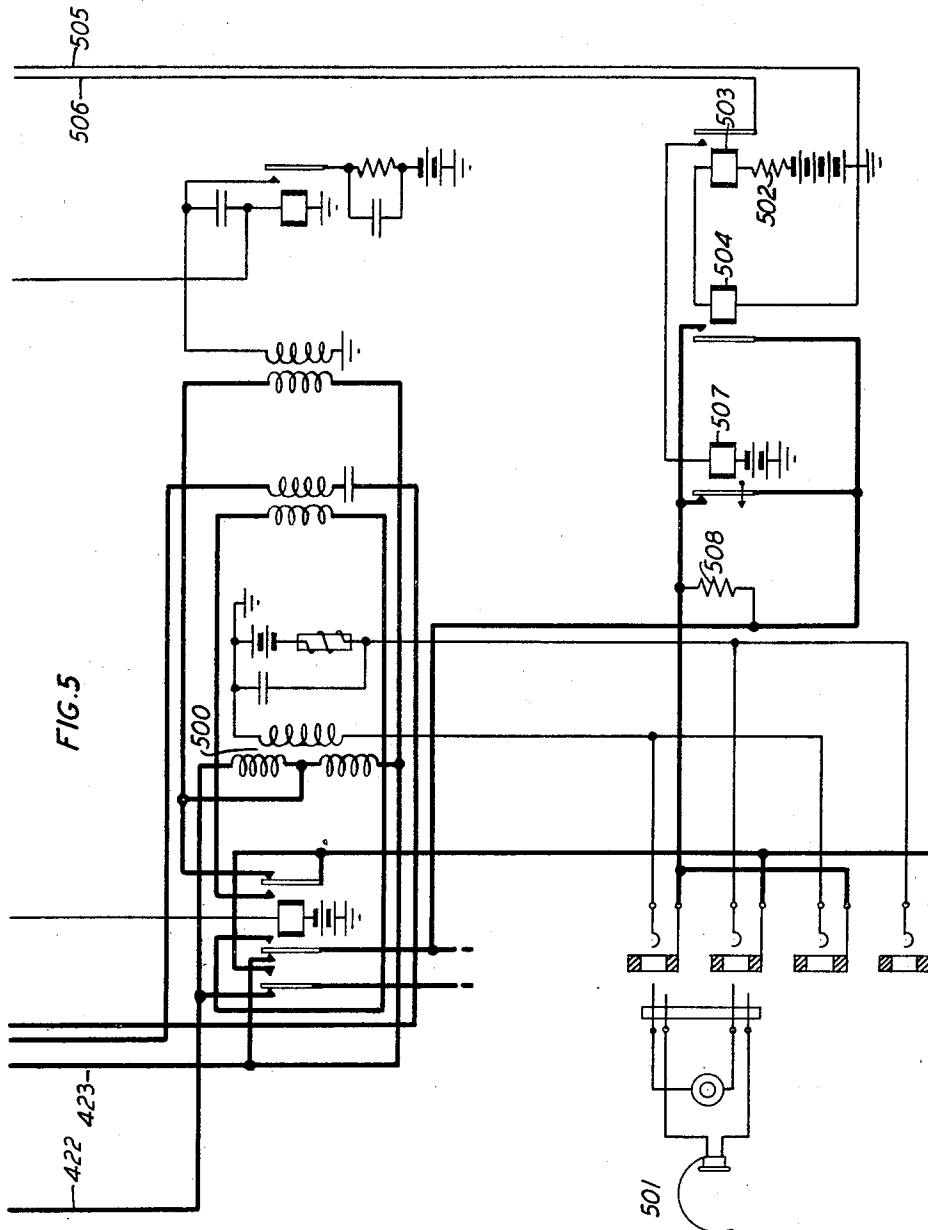
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TELEPHONE SYSTEM

Filed May 17, 1933

5 Sheets-Sheet 5



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UNITED STATES PATENT OFFICE

1,946,228

TELEPHONE SYSTEM

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Application May 17, 1933. Serial No. 671,467

16 Claims. (Cl. 179-6.3)

This invention relates to telephone exchange systems and more particularly to systems in which connections to toll points are established through a toll operator's position and toll is assessed against calling subscribers by means of coin boxes associated with their lines.

The object of the invention is to simplify the means whereby the toll operator is enabled to collect or refund coins deposited in the coin box of a calling line which is associated over completing-recording or toll switching trunks with the toll operator's position.

Heretofore it has been customary in order to enable a toll operator to control coin collection or refund to provide an additional coin jack for each toll switching or recording-completing trunk terminating at the toll operator's position connected by a separate cable conductor to the distant end of the trunk at the originating office and to provide a special coin control plug at the toll operator's position equipped with coin collect and refund keys. In systems of this character when the toll operator has established the toll connection with her regular toll cord circuit and desires to either collect or refund deposited coins, she plugs her coin control plug into the coin jack assigned to the trunk employed to establish the toll connection and depresses either the coin collect or refund key associated with the coin plug. The depression of a coin key controls, over the extra cable conductor or coin control trunk allotted to the trunk employed, relays associated with the originating office end of the toll trunk which in turn apply coin box control current to the coin box of the calling line to either collect or refund coins deposited therein.

In accordance with the present invention the special coin jacks and coin control plugs have been eliminated from the toll operator's position and the positional coin control keys formerly associated with the coin control plugs have been arranged to be associated directly with any toll cord circuit of the toll operator's position when the talking key of such cord circuit is thrown into the talking position. Coin control relays responsive to the coin control keys are then provided in toll office end of a coin control trunk included in the interoffice cable extending from the local office to the toll office which are operable over one of the talking conductors of the connected toll cord circuit and toll trunk. These relays in turn control coin box control relays in the coin control trunk at the local office end thereof over the common coin control trunk which latter relays then control the coin box of

the calling line in the local or originating office.

For the purposes of illustration the invention has been illustrated in connection with a group of recording-completing trunks extending from the multiple bank of a district selector of a panel type machine switching office to a toll operator's position, provision being made for exercising coin control for connections established over any of the trunks over a common coin control trunk circuit extending between the toll office and the panel office. For this purpose the common control trunk terminates at the toll office in a finder switch which is operated when the toll operator plugs into the terminating jack of any interoffice recording-completing trunk and operates a position coin control key for locating the particular trunk to which the operator has connected. The common control trunk also terminates at the panel office end thereof in a similar finder switch which operates in synchronism with the first switch to find the panel office end of the trunk to which the operator has connected. When the two ends of a trunk are thus selected the operator is enabled to control coin relays associated with the toll office end of the coin control trunk which in turn control coin relays associated with the panel office end of the coin control trunk over the common coin control trunk. With this embodiment of the invention a distinct saving in interoffice cable conductors is realized, but if a sufficient number of cable conductors are available so that a separate coin control conductor may be used for each recording-completing trunk, the finder switches may be omitted.

It will, of course, be obvious that a common coin control trunk and finder switches may be used in connection with the group of toll switching trunks. It will be further obvious that the invention may be employed in connection with toll trunks extending from either manual or step-by-step type offices to toll offices.

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

Fig. 1 shows schematically a calling subscriber's line equipped with a coin box, a line finder and district selector for extending a connection from the subscriber's line to the outgoing end of a toll recording-completing trunk, a link circuit comprising a district finder switch and a sender selector switch and a sender which may be associated with the district selector and controlled by

the subscriber's dial for setting the district selector;

Fig. 2 shows the local office end of a two-wire recording-completing trunk extending to a toll recording operator's position and in the lower portion thereof the outgoing end of a coin control trunk common to a plurality of recording-completing trunks and terminating in a finder switch for associating it with any one of the recording-completing trunks, and the schematic representation of the outgoing end of a second coin control trunk;

Fig. 3 shows the distant or toll office end of the recording-completing trunk disclosed in Fig. 2, the distant end of the common coin control trunk which terminates in a finder switch for the association thereof with the distant end of any one of the recording-completing trunks, and the schematic representation of the distant end of a second coin control trunk;

Fig. 4 shows a cord circuit of a toll recording and completing operator's position having access to the jacks of trunks such as that shown in Fig. 3 together with control relays and keys of the operator's position;

Fig. 5 shows the telephone set of the operator's position; and,

Fig. 6 is a diagram showing the manner in which the several figures of the drawings should be arranged to completely disclose the invention.

It will be assumed that the calling subscriber whose substation apparatus 100 is shown in Fig. 1 desires a toll connection and for that purpose removes his receiver from the switchhook and then dials the required number for routing a connection from his line over a trunk to the position of a toll recording and completing operator. Upon the removal of the receiver from the switchhook, a start circuit is closed in the manner fully described in Patent 1,862,549, granted June 14, 1932, to R. Raymond and W. J. Scully, whereupon line finder 101 is caused to hunt for and connect with the terminals of the calling line and an idle register sender 102 is associated with the calling line over brushes of the sender selector and district finder switches 103 and 104. The subscriber receives the usual dial tone when the sender has been connected with his line and then proceeds to dial the proper code of digits to set the registers of the sender to record the fact that a connection with a toll operator's position is desired. The sender then proceeds to set the district selector 105 to select an idle trunk extending to the operator's position.

When the brushes of the district selector are positioned on the terminals of an idle trunk, for example, the trunk shown in Figs. 2 and 3, a circuit is established from battery, upper back contact of relay 201, upper back contact of relay 202, upper left winding of repeating coil 203, upper back contacts of relays 204 and 205, tip trunk conductor 206, terminal 106 and brush 107, thence through the winding of the trunk test relay, not shown, of the sender 102, returning over the right contacts of cam 109, brush 110 and terminal 111, ring trunk conductor 207, lower back contacts of relays 205 and 204, lower left winding of repeating coil 203, lower back contact of relay 201 to ground through the lower winding of relay 200. The trunk test relay of the sender operates over this circuit but relay 200 does not, and causes the sender to advance the sequence switch of the district selector 105 to the trunk closure position whereupon the sender is dis-

missed from the connection. The circuit of relay 200 is now extended from brush 107, over the upper contacts of cam 108, upper right winding of repeating coil 112, contacts of cam 114, winding of polarized relay 113, lower right winding of repeating coil 112, lower left and upper right contacts of cam 109, to brush 110, thence as traced. Relay 200 operates in this circuit, but the current does not flow in the proper direction to operate relay 113.

Relay 200 upon operating closes a circuit extending from ground at its contact, over the lower back contact of relay 208 to battery through the winding of relay 209. Relay 209 operates in this circuit, at its lower front contact connecting ground to the sleeve terminal 115 to prevent the selection of the trunk by another district selector and at its upper contact closing a circuit extending from ground over the upper back contact of relay 210 to battery through the winding of slow-to-release relay 211. Relay 211 operates closing over its upper contact an obvious circuit through the windings of relays 201 and 212 in parallel and over its lower contact establishing a supplementary busy ground on terminal 115. Relay 201 upon operating establishes a circuit which extends from battery through the upper winding of relay 200, lower front contact of relay 201, thence as traced through the winding of polarized relay 113 at the district selector and thence as traced through the upper left winding of repeating coil 203, upper back contact of relay 202, upper front contact of relay 201, lower winding of relay 200 to ground. Both windings of relay 200 are now included in series with the winding of relay 113 and the direction of current flowing through the winding of relay 113 is reversed so that relay 113 now operates and advances the sequence switch of the district selector to the cut-through position 16 in which the circuit of relay 200 is disconnected from the winding of relay 113 and is extended from brush 107, over the upper contacts of cam 116, thence over the subscriber's line loop returning through the winding of supervisory relay 117 and the lower contacts of cam 118 to brush 110. Relay 200 is now held operated over the subscriber's line loop.

Relay 212 upon operating connects ringing induction tone from ringing source 213, upper front contact of relay 212, upper back contact of relay 208, condenser 214, lower back contacts of relays 204 and 205, conductor 207, thence as traced over the calling line loop to ground through the lower winding of relay 200, as a signal that the operator is being called, closes a circuit from battery over its inner lower front contact, winding of relay 215, resistance 216 to ground at the back contact of relay 217 thereby operating relay 215, and establishes a circuit from battery, lower winding of relay 218, lower front contact of relay 212, inner lower front contact of relay 209 which operated previously, lower right winding of repeating coil 203, trunk conductor 219, lower back contact of relay 300, lower left winding of repeating coil 301, both windings of polarized relay 302 in series, upper left winding of repeating coil 301, upper back contact of relay 300, trunk conductor 220, upper right winding of repeating coil 203, inner upper front contact of relay 209, inner upper front contact of relay 212 to ground through the upper winding of relay 218. Polarized relay 302 at the toll office operates in this circuit, but due to its high resistance marginal relay 218 at

the local office does not receive sufficient current to operate. Relay 302 upon operating causes the operation of relay 303 in a circuit extending from ground at the front contact of relay 302, upper back contact of relay 304 to battery through the winding of relay 303 which in turn establishes an obvious circuit for lighting the trunk lamp 305.

The toll operator seeing the trunk lamp 305 lighted plugs the answering plug 400 of her cord circuit into jack 306 of the trunk thereby establishing a circuit from battery through the answering supervisory lamp 401 and resistance 402 in parallel, right back contact of relay 403, sleeves of plug 400 and jack 306 to ground through the lower high resistance winding of sleeve relay 307. Relay 307 operates, but due to the high resistance of the lower winding of relay 307 the supervisory lamp 401 does not light. Relay 307 causes relay 304 to operate over an obvious circuit which releases relay 303 thereby extinguishing the trunk lamp 305, bridges condenser 308 between the inner terminals of the left windings of repeating coil 301 to establish a talking circuit and shunts the lower high resistance winding of relay 302. With the high resistance winding of relay 302 shunted relay 218 now receives sufficient current to operate and closes an obvious circuit for relay 221 which operates.

Relay 221 upon operating establishes over its lower contact an obvious circuit for relay 210 and establishes a circuit from ground at the front contact of relay 200, over the upper front contact of relay 221 to battery through the winding of relay 209 for holding this relay operated after relay 208 operates as will be presently described, to prevent the reoperation of relay 209 after both the calling subscriber and the toll operator have disconnected at the end of the call. Relay 210 upon operating closes obvious operating circuits for relays 208 and 222, opens at its upper back contact the operating circuit of relay 211 and closes a new circuit for relay 221 extending from battery, through the winding of relay 221, upper front contact of relay 210 to ground at the upper front contact of relay 209 thus placing relay 221 under the control of both the calling subscriber and the toll operator. Relay 211 which is slow to release does not have time to release before a holding circuit therefor is established through the operation of relay 222 in circuit from battery, through the winding of relay 211 to ground at the inner lower front contact of relay 222.

Relay 208 upon operating locks itself operated over its inner lower front contact to ground at the upper contact of relay 211, opens at its lower back contact the initial operating circuit of relay 209, opens at its upper back contact the circuit from ringing source 213 to discontinue the application of tone to the calling line as a signal that the toll operator has answered, closes at its upper front contact the talking circuit through condenser 223 and the right windings of repeating coil 203, prepares at its inner upper front contact a circuit for operating ring-back relay 204 whenever relay 215 releases, and at its lower front contact closes a circuit extending from ground, over the lower contact of relay 210, upper back contact of relay 224 to battery through the lower winding of relay 202 thus operating relay 202. Relay 208 also at its lower front contact connects ground over the lower front contact of relay 222, the lower front contact of relay 224, when operated, through the

winding of relay 222 to battery for holding relay 222 operated when relay 210 releases at the end of the call.

Relay 222 upon operating connects the source of negative 110-volt coin return current from source 225 over the inner upper front contact of relay 222, to the lower contact of relay 226, closes a holding circuit for relay 209 extending over its upper alternate contacts to ground at the lower front contact of relay 202 to prevent relay 209 from releasing during coin box control, closes at its lower front contact a point in its own locking circuit, previously traced, and at its lower back contact opens a shunt path around the lower contact of relay 210.

The operation of relay 202 opens at its upper back contact a point in the talking battery supply circuit to the calling line, closes an obvious circuit from battery over its upper front contact through the winding of relay 227 to ground through the interrupter 228 which causes relay 227 to operate and release at the rate of 60 times per minute. Upon each operation of relay 227 a circuit is established from ground at its front contact over the lower intermediate front contact of relay 202 to battery through the winding of relay 229. Relay 229 operates and closes a circuit extending from battery through the upper winding of relay 226, lower contact of relay 229, upper back contact of relay 230, inner upper normal contacts of relay 231, lower front contact of relay 210 to ground at the lower front contact of relay 208. Relay 226 locks in a circuit from battery through resistance 232, inner lower front contact and lower winding of relay 226, lower contact of relay 210 to ground at the lower front contact of relay 208 and closes a circuit for operating relay 205 extending from battery, winding of relay 205 to ground at the upper front contact of relay 226. With relays 222, 226 and 205 now operated, the negative 110-volt source 225 of refunding current is now connected over the circuit previously traced, through the lower front contact of relay 226, thence over the outer front contacts of relay 205 and in parallel over trunk conductors 206 and 207 through the winding of coin box magnet 119 to ground at contacts closed by the deposited coin thus causing the coin to be returned to the coin return chute. During the operation of relay 205 the talking circuit is held open at its outer back contacts and relay 202 is held operated in a circuit extending from ground at the inner lower front contact of relay 205 to battery through the upper winding of relay 202. At the end of a half second interval the interrupter 228 opens the circuit of relay 227 which releases in turn releasing relay 229. With relay 226 operated the release of relay 229 closes a circuit extending from battery, winding of relay 230, upper front contact of relay 226, back contact of relay 229, lower front contact of relay 210 to ground at the lower front contact of relay 208. Relay 230 now operates and locks over its upper front contact and the upper normal contacts of relay 231 to ground at the lower front contact of relay 208 and at its lower front contact establishes a holding circuit for relay 205. Upon the next operation of relays 227 and 229 when interrupter 228 closes, with relay 230 now operated, a circuit is closed in shunt of the lower locking winding of relay 226 extending over the upper front contact of relay 229, inner upper front contact of relay 230, inner lower front contact of relay 226 and since the initial operating circuit of relay 226

is open at this time at the upper back contact of relay 230, relay 226 releases to open at its lower front contact the circuit over which refund current was applied to the coin box, to open at its upper front contact the initial operating circuit of relay 230 and to open at its inner upper front contact the initial operating circuit of relay 205.

At the end of a one half second interval interrupter 228 releases relays 227 and 229 and with relay 226 now released a circuit is closed from battery, winding of relay 231, inner lower front contact of relay 230, upper back contact of relay 226, upper back contact of relay 229 to ground, as traced, at the lower front contact of relay 208. Relay 231 operates and locks over its inner upper alternate contacts to ground at the lower front contact of relay 208 and opens at its inner upper normal contacts the holding circuit of relay 230 which now releases in turn opening at its lower front contact the holding circuit of relay 205. Relay 205, however, does not release at this time since it is now held operated over a circuit extending over the lower front contact of relay 231, the inner lower front contact of relay 202, back contact of relay 224 to ground as traced at the lower front contact of relay 208. Relay 231 at its upper back contact disconnects the condenser 233 and resistance 234 from the coin return circuit, previously traced, which were effective during coin return to absorb current surges. Relay 230 upon releasing with relay 231 operated closes a circuit for operating relay 224, extending from battery, winding of relay 224, middle lower front contact of relay 231, lower back contact of relay 230, back contact of relay 226, back contact of relay 229 to ground at the lower front contact of relay 208.

Relay 224 upon operating locks over its inner upper front contact, inner upper alternate contacts of relay 231 to ground as traced at the lower front contact of relay 208, opens at its upper back contact the holding circuit of relay 205 which now releases, opens at its upper back contact the initial operating circuit of relay 202 which now releases since the holding circuit through its upper winding was opened upon the release of relay 205, and at its lower front contact completes the previously traced holding circuit of relay 222. With relay 205 released the talking circuit is re-established from the calling line to the repeating coil 203. Relay 202 upon releasing opens the operating circuits of relays 227 and 229 to prevent their reoperation during the establishment of the connection, restores the connection of the battery supply circuit and removes holding ground from the winding of relay 209 so that relay 209 is now under the control of the calling subscriber over contacts of relay 200. The trunk circuit is now in condition for the calling subscriber to talk with the operator.

The toll operator after connecting with the recording-completing trunk operates her talking key 404 to the right or talking position. A circuit is thereby closed from battery through the left windings of relays 405 and 403 in parallel, upper right alternate contacts of key 404 to ground at the normal contacts of relay 407. It is to be noted in this connection that all of the apparatus below the dot-dash line in Fig. 4 and all apparatus of Fig. 5 is positional apparatus common to all cord circuits of the position, one such cord circuit being disclosed in the upper portion of Fig. 4. Relay 403 upon operating transfers the circuit previously traced over the sleeve of plug 400 from battery through lamp 401 to battery

in series through the winding of marginal relay 409 and relay 410. Relay 410 now operates in series with relay 307, but relay 409 does not. Relay 410 in turn closes an obvious circuit for operating relay 411. Lamp 401 is now connected into a circuit extending over the inner right front contact of relay 403, through high resistance 412 to ground at the left front contact of relay 411. Due to high resistance 412, lamp 401 does not light. At its inner left contact relay 403 similarly transfers the sleeve conductor of plug 408 from connection with lamp 413 and resistance 414 to the windings of relays 415 and 416 and transfers the circuit of lamp 413 to the inner left contact of relay 417 through high resistance 418. With relays 405 and 403 both operated a circuit is closed for operating relays 407 and 419 which may be traced from battery through the windings of these relays in parallel, outer left contacts of relays 403 and 405 to ground at the lower right alternate contacts of key 404. With relay 407 operated the initial operating circuit of relays 405 and 403 is opened and a holding circuit for them is closed through their right windings in parallel, the inner right front contact of relay 405 to ground at the alternate contacts of relay 407.

Relay 405 upon operating at its outer right and inner left contacts opens the talking conductors normally extending from the tip of plug 400 to the tip of plug 408 and from the ring of plug 400 to the ring of plug 408, and with relay 411 operated establishes a talking circuit which may be traced from the upper right winding of repeating coil 301, over the tips of jack 306 and plug 400, inner lower right normal contacts of relay 405, upper right normal contacts of key 421, right front contact of relay 411, conductor 422, left windings of repeating coil 500, conductor 423, inner left normal contacts of key 424, inner upper right normal contacts of key 424, lower inner right normal contacts of key 421, inner left alternate contacts of relay 405, rings of plug 400 and jack 306 to the lower right winding of repeating coil 301. With her headset 501 plugged up the talking circuit just traced is inductively connected over the right winding of repeating coil 500 and the operator is thereby enabled to talk with the calling subscriber to receive information for completing the connection. The operator after receiving instructions from the calling subscriber then proceeds to complete the connection in the well known manner.

It will first be assumed that the establishment of the desired connection is successful and that the calling subscriber has been informed by the operator to deposit the required coin in the coin box of the coin line in payment for the connection. To collect the deposited coin the operator will maintain the talking key 404 thrown to the right or talking position and will operate key 424 to the right or collecting position. A circuit is thereupon established from 48-volt battery through resistance 502, the windings of relays 503 and 504 in series, conductor 505, upper right alternate contacts of key 424, lower right normal contacts of key 421, left alternate contacts of relay 405, rings of plug 400 and jack 306, lower right winding of repeating coil 301, windings of differential relay 309, in parallel with the circuit through resistance 322 to ground through the 24-volt battery. The lower winding of relay 309 being wound with more turns than the upper differential winding relay 309 operates. Relays 503 and 504 also operate.

With key 424 operated a circuit is established from ground at its lower right alternate contacts, over conductor 506, the contact of relay 503 to battery through the winding of slow-to-release relay 507. Relay 504 upon operating completes a circuit in multiple with the contacts of relay 507 for short-circuiting resistance 508 in the operator's receiver circuit. Relay 507 upon operating following the operation of relays 503 and 504 opens one short-circuiting path, but relay 504 being operated retains the other path. When the key 424 is restored relays 503, 504 and 507 release, relay 504 opening one short circuit around resistance 508 before relay 507 has time to release to restore the other short-circuiting path. Thus, during the releasing time of slow-to-release relay 507, the resistance 508 is included in the operator's receiver circuit for a sufficient time to discharge the receiver before it is restored to its normal efficiency and thus to reduce the click incident to the application of coin control current to the talking circuit.

Relay 309 upon operating closes a start circuit which is common to a group of recording-completing trunks, extending from ground at the lower front contact of relay 309, start conductor 321, upper back contact of relay 310 to battery through the winding of relay 311. Relay 311 operates closing a loop impulsing circuit over conductors 312 and 313 of the first of a group of coin control trunks common to all of the recording-completing trunks, which may be traced from ground, lower back contact of relay 239, conductor 312, lower front contact of relay 311, winding of relay 314, conductor 313, winding of relay 236, normal contact and wiper 237 of finder switch 250 to battery. Relays 314 and 236 operate. Relay 314 upon operating closes an obvious circuit for stepping magnet 315 of finder switch 350 but the switch being of a type which steps only on the release of its stepping magnet does not step off normal.

At the local office end of the coin control trunk relay 236 upon operating closes an obvious circuit for slow-to-release relay 238 and closes a circuit from ground at its front contact, upper back contact of relay 239, winding of timing relay 240, upper back contact of timing relay 241 to battery. Relay 240 operates closing an obvious circuit for timing relay 241 which operates opening the operating circuit of relay 240. Relay 240 which is of the slow-to-release type starts to release and opens the operating circuit of relay 241 which is also slow-to-release. Thus, following the release of relay 240 and before relay 241 has time to release, a circuit is closed from ground at the back contact of relay 240, front contact of relay 241, winding of stepping magnet 242, to battery at the lower front contact of relay 238. Magnet 242 operates preparatory to stepping the wipers of finder switch 250 but switch 250 being of the type which advances its wipers upon the deenergization of its stepping magnet does not step. Magnet 242 at its upper front contact connects a shunting ground from the front contact of relay 236, upper contact of magnet 242 to trunk conductor 313 which shunts relay 314 causing it to release and open the circuit of stepping magnet 315 thereby advancing finder switch 350 one step. Relay 236, however, remains operated from battery supplied over the inner lower front contact of relay 238.

When timing relay 241 releases after an interval with relay 236 still operated, the circuit of stepping magnet 242 is opened to advance finder

switch 250 one step and to restore the operating circuit of timing relay 240. The release of magnet 242 removes the shunt from around relay 314 which then reoperates to cause the reenergization of stepping magnet 315. In this manner timing relays 240 and 241 function to cause the intermittent operation and release of stepping magnet 242 to advance the wipers of switch 250 and the intermittent application of shunting ground to trunk conductor 313 to thereby cause the step-by-step advance of the wipers of finder switch 350. This action continues until wiper 316 of switch 350 finds a terminal allocated to the recording-completing trunk to which the operator has connected her cord circuit, when a circuit is established from ground at the inner front contact of relay 309, wiper 316, upper front contact of relay 311, upper normal contacts of relay 317, windings of relays 318 and 319 in series, wiper 328, upper winding of relay 309, thence as traced to battery through the windings of relays 503 and 504. Relays 318 and 319 both operate in this circuit since the toll operator has thrown key 424 to the right or coin collection position and resistance 425 is not included in the circuit. It will be noted that the circuit previously traced from ground through the windings of relays 318 and 319 to the upper winding of relay 309 is in shunt of the lower winding of relay 309 and relay 309 being differentially wound now releases removing ground from the start conductor 321 and opening the initial operating circuit for relays 318 and 319.

Relay 318 in the meantime, however, has closed an obvious operating circuit for relay 317 which at its inner upper alternate contacts connects operating ground to the circuit traced through the windings of relays 318 and 319 to hold these relays operated following the removal of the initial operating ground when relays 309 and 311 release. Relay 317 also closes a circuit from ground at its upper front contact through the lower winding of relay 310 to battery, whereupon relay 310 operates and locks over its inner lower front contact to off-normal ground over wiper 320. At its upper back contact relay 310 disconnects the winding of relay 311 from the common start conductor 321 and extends the start conductor over its upper front contact, the upper back contact of relay 310' of the next finder switch circuit 360 to the winding of a relay corresponding to relay 311 so that if there is another recording-completing trunk of the same group awaiting connection to a coin control trunk, for example, the trunk to which relay 309' is individual, a second finder switch, similar to switch 350 and paired over a second coin control trunk 312', 313', with another finder switch 260 similar to switch 250 will be effective. Such finder switches are indicated by the rectangles 260 and 360 of Figs. 2 and 3, respectively.

It is to be noted in this connection that the bank terminals of the finder switches associated with either end of the coin control trunk are slip-multiplied in the well known manner so that, for example, the group of recording-completing trunks which are first choice to finder switches 350 and 250, are second choice to the finder switches 360 and 260 associated with the second coin control trunk, and third choice to the finder switches associated with a third coin control trunk if employed. Also, the finder switches associated with the second coin control trunk, schematically indicated at 360 and 260, have first choice access to a second group of recording-com-

pleting trunks, the start relay of one such trunk being shown at 309². Similarly, the finder switches associated with a third coin control trunk would have first choice access to a third group of recording-completing trunks. Further, each finder switch 350 and 250 may be equipped with a second set of three banks and wipers, not shown, the second set of wipers being insulated from the wipers shown and positioned on the shaft 180 degrees from the wipers shown. Thus each finder may have access to a group of 44 trunks.

It will be recalled that relay 310 operated when the calling recording-completing trunk was found by the finder switch 350 and opened the circuit of relay 311. Relay 311 upon releasing opens the impulsing loop over the coin control trunk conductors 312 and 313 extending through the winding of relay 236 at the local office end thereof. Relay 236 does not release, however, until magnet 242 releases, since it is held over a local circuit extending from ground at its front contact, upper contacts of magnet 242 to battery at the inner lower front contact of relay 238. When magnet 242 releases to complete the last step of finder 250, relay 236 releases opening the circuit of relay 238, but relay 238 being slow-to-release does not have time to release before its operating circuit is reestablished as hereinafter described. A circuit is now closed from ground at the back contact of relay 236, upper front contact of relay 238, winding of relay 239, inner lower front contact of relay 238 to battery, and relay 239 locks in a circuit from ground over its lower front contact and winding to battery at the inner lower front contact of relay 238. At its upper contact relay 239 transfers the control circuit from the front contact of relay 236 from the winding of timing relay 240 to the winding of relay 243, and at its lower back contact opens the shunt around the winding of marginal relay 235. A circuit over the coin control trunk is now established from ground, winding of relay 235, conductor 312, lower back contact of relay 311, resistance 323, winding of relay 324, lower front contact of relay 317, conductor 313, winding of relay 236 to battery at the inner lower front contact of relay 238. Relay 324 operates in this circuit but due to the inclusion of resistance 323, since relay 319 was assumed to have operated denoting coin collection, marginal relay 235 does not operate, and since the winding of relay 324 is of high resistance relay 236 does not operate.

Relay 324 upon operating closes an operating circuit for relay 325 extending from battery, winding of relay 325, contact of relay 324, to ground at the inner lower front contact of relay 317. Relay 325 upon operating locks over its lower front contact to ground at the inner lower front contact of relay 317, independent of the contacts of relay 324, and establishes a shunt around the winding of relay 324 over its upper contact whereupon relay 324 releases. The high resistance of the winding of relay 324 being now shunted relay 236 operates and closes the circuit of relay 243 which may be traced from ground at the front contact of relay 236, upper front contact of relay 239, to battery through the winding of relay 243. Relay 236 also closes the operating circuit of relay 238. Relay 243 upon operating establishes a circuit from ground, lower front contact of relay 243, choke coil 244, wiper 245 and the terminal of its bank to which it has been advanced, which terminal is allocated to the local

office end of the recording-completing trunk to which the toll operator has connected her cord circuit, the inner lower front contact of relay 231 to battery through the lower winding of relay 202. Relay 202 operates establishing a holding circuit for relay 209 extending from ground at its lower front contact over the upper alternate contacts of relay 222, winding of relay 209 to battery for holding relay 209 from releasing during the coin control period, disconnects at its upper back contact the talking battery connection from the upper left winding of repeating coil 203, and extends its own operating circuit over its inner lower front contact, the lower front contact of relay 231 to battery through the winding of relay 205. Relay 205 now operates over the circuit previously traced to ground at the lower contact of relay 243. Relay 202 also closes the operating circuit of relay 227 which in turn causes the operation of relay 229, but relays 227 and 229 operate without function at this time since relay 231 is operated.

Relay 205 upon operating closes an obvious circuit through the upper winding of relay 202 for holding it operated, opens the connection between trunk conductors 206 and 207 and the left windings of repeating coil 203 and connects these trunk conductors over its outer front contacts, the inner lower front contact of relay 224, wiper 246, the inner upper front contact of relay 243, the lower back contact of relay 247, the upper winding of relay 248, the inner upper back contact of relay 247 to the source 249 of positive 110-volt collection current. If a coin has been deposited by the calling subscriber in response to the request of the operator, magnet 119 of the coin box will operate to collect the coin and relay 248 will also operate locking from ground over its inner lower front contact and lower winding to battery at the inner lower front contact of relay 238 and establishing a tone circuit from the source of low tone, upper normal contacts of relay 247, upper contact of relay 243, lower contact of relay 248, wiper 245, middle lower front contact of relay 224, inner upper front contact of relay 205, upper back contact of relay 204, upper left winding of repeating coil 203, lower front contact of relay 201, upper winding of relay 200 to battery. The tone current is induced from this circuit through the right windings of repeating coil 203 into the talking circuit previously traced extending to the toll operator's headset 501.

The operator hearing this tone is apprised of the fact that the coin has been deposited and collected. She then restores key 424 thereby releasing relays 503, 504, 318 and 319, relays 503 and 504 performing upon their release the function previously described and relay 318 causing in turn the release of relays 317 and 325. With relay 317 released a self-interrupting circuit for stepping magnet 315 is closed from battery, winding and interrupter contacts of magnet 315, lower back contact of relay 317, lower front contact of relay 310, off-normal terminals and wiper 320 to ground. When magnet 315 has stepped the wipers of finder switch 350 to normal, the circuit of magnet 315 is opened at wiper 320 thus arresting the switch with its wipers in their normal positions. With wiper 320 in its normal position, the locking circuit of relay 310 is opened and relay 310 releases unless ground has in the meantime been connected to common start conductor 321 by another trunk relay such as 309. In that case, relay 310 is held operated in a circuit from ground on common start conductor

321, upper front contacts and upper winding of relay 310 to battery at the lower front contact of master relay 326. When calls are present at the same time in all groups of trunks and all relays 310, 310', etc., are operated, master relay 326 releases to close an all trunk busy circuit and to prevent the locking up of all relays 310, 310', etc. This is to prevent a call initiated when all groups of trunks have calls awaiting attention from holding all coin control trunks busy until ground is removed from the common start conductors.

The release of relays 317 and 325 opens the loop circuit over the coin control trunk conductors 312 and 313 thereby releasing relay 236 which in turn releases relays 243 and 238. Relay 238 in turn releases relays 239 and 248 and closes a self-interrupting circuit for stepping magnet 242 extending from battery, wiper 237 and the strapped off-normal terminals of its bank, winding and interrupter contacts of magnet 242, upper bank contact of relay 238, to ground at the back contact of relay 236. Magnet 242 steps the wipers of finder switch 250 to their normal positions whereupon the circuit of magnet 242 is opened to arrest further stepping. In the event of a reselection at the toll end of the coin control trunk no action may take place until the local finder 250 reaches normal since battery is removed from the winding of relay 236 by the release of relay 238 and is not restored until wiper 237 reaches its normal terminal.

Relay 243 upon releasing opens the circuit of relay 205 and the circuit through the lower winding of relay 202. Relay 205 releases restoring the talking connection, opening the holding circuit through the upper winding of relay 202, opening the circuit over which tone is applied to the toll operator's headset and disconnecting the coin box control battery from the trunk conductors 206 and 207. Following the release of relay 205, relay 202 releases, restoring the control of relay 209 to the calling subscriber, reestablishing the connection of talking battery through the upper left winding of repeating coil 203, and releasing relays 227 and 229. The completing-recording trunk is now restored to the talking condition and the apparatus for enabling coin control over a common coin control trunk is restored for use on another toll call.

Had the operator found it necessary to refund a coin deposited in the coin box of the calling line she would have thrown key 424 to the left thus establishing a circuit from battery as traced through the windings of relays 503 and 504, conductor 505, resistance 425, inner upper left alternate contacts of key 424, upper right normal contacts of key 425, thence as traced to ground through both windings of relay 309. Relay 309 operates to perform the functions previously described for causing the setting of the finder switches 350 and 250 to select terminals allocated to the toll and local office ends of the recording-completing trunk. As soon as finder switch 350 finds the trunk to which the operator has connected, the windings of relays 318 and 319 are connected in parallel with the lower winding of relay 309 to the circuit previously traced to battery through resistance 425 and the windings of relays 503 and 504. Since resistance 425 is now included marginal relay 319 does not operate and consequently resistance 323 remains short-circuited. When thereafter, as previously described, the loop circuit over the coin control trunk is closed through the windings of relays 235 and 326, following the setting of finders 250

and 350, relay 236 operates to perform the functions previously described and marginal relay 235 also operates to close an obvious operating circuit for relay 247. Relay 247 upon operating locks over its lower front contact, the upper front contact of relay 239, to ground at the front contact of relay 236.

Relay 243 operates as previously described in turn causing the operation of relays 202 and 205. Since relay 247 is now operated, a coin box control circuit is established from the source 225 of negative 110-volt refunding current, inner lower front contact of relay 247, upper winding of relay 248, inner upper front contact of relay 247, inner upper front contact of relay 243, wiper 246, thence as traced over the outer front contacts of relay 205, conductors 206 and 207 to ground at the coin box through the winding of the coin box magnet 119. Magnet 119 operates to refund the coin if a coin has been deposited and relay 248 operates and locks as previously described and establishes a tone circuit from the source of high tone over the upper alternate contacts of relay 247, the upper front contact of relay 243, the lower front contact of relay 248, thence as traced over the inner upper front contact of relay 205 whereby the toll operator is given a tone signal that the coin has been deposited and refunded. The restoration of the coin control trunk apparatus is effected in the manner previously described.

The connection is held as long as the toll operator's cord circuit is connected to jack 306 of the trunk or the calling subscriber has his receiver off the switchhook. When the calling subscriber disconnects relay 200 releases in turn releasing relay 209. Relay 209 upon releasing reverses the connection of battery and ground to the conductors 219 and 220 of the interoffice trunk whereupon polarized relay 302 releases. The release of relay 302 connects ground to the upper winding of sleeve relay 307 thereby lowering the resistance of the sleeve circuit extending as previously traced if the talking key 404 is still operated, to battery through the windings of relays 409 and 410 to such an extent that marginal relay 409 operates to connect low resistance 427 in parallel with high resistance 412 in the circuit of answering supervisory lamp 401. Lamp 401 now lights as a disconnect signal. If the talking key has been restored thus releasing relays 403 and 405, the sleeve circuit extends directly to battery through lamp 401 as previously traced and lamp 401 lights.

The operator upon seeing lamp 401 light disconnects her cord circuit from trunk jack 306 thereby releasing relays 307 and 304. Relay 304 upon releasing removes the short circuit from the lower high resistance winding of relay 302 thereby increasing the resistance of the circuit through the windings of marginal relay 218 to such an extent that relay 218 releases in turn releasing relay 221. Relay 221 causes the restoration of relay 210 and opens the circuit of relay 209 to prevent its reoperation. Relay 210 upon releasing opens the holding circuit of relays 224 and 231 which now release, relay 224 in turn releasing relay 222. Relay 202 now operates in a circuit extending from battery through its lower winding, upper back contact of relay 224, lower back contact of relay 222 to ground at the lower front contact of relay 208. With relay 222 released the formerly traced locking circuit for relay 211 is opened, but a new holding circuit for relay 211 is closed by the operation of relay 202 which may be traced from battery, winding

of relay 211, upper back contact of relay 222 to ground at the lower front contact of relay 202. Relays 202, 227, 229, 226, 205, 230, 231 and 224 now function in the manner previously described in connection with the automatic return of the initially deposited coin except that since relay 222 is not at this time operated current is applied from the positive 110-volt source of collecting current 249 over the inner upper back contact of relay 222, lower front contact of relay 226, front contacts of relay 205 to the coin box magnet 119 of the calling line for the purpose of insuring that any deposited coin will be collected. When relays 231 and 224 are operated in the manner previously described, relay 202 releases and in turn releases relay 211. Relay 211 removes ground from the sleeve terminal 115 of the district selector to initiate the release of the district selector 105 and line finder 101 and opens the holding circuit for relays 201, 208 and 212 which relays release. Relay 208 upon releasing releases relays 231 and 224. All apparatus used in establishing the connection to the toll office has now been restored to normal.

What is claimed is:

1. In a telephone exchange system, a local office, a calling line terminating therein and having a coin box thereon, an operator's position, a trunk for connecting said local office with said operator's position, cord circuits and coin control keys common thereto at said operator's position, a talking key for each cord circuit for associating said coin control keys with said cord circuit, and coin control relays associable with the trunk for controlling said coin box and controllable by said coin control keys over the trunk and connected cord circuit.

2. In a telephone exchange system, a local office, a calling line terminating therein and having a coin box thereon, a distant office, means including an interoffice trunk for connecting said offices, an operator's position at said distant office having cord circuits for connection with said interoffice trunk and coin control keys, a talking key for each cord circuit for associating said coin control keys with said cord circuit, a coin control trunk extending from the distant office to the local office, coin control relays associated with the distant office end of said coin control trunk and controllable by said coin control keys over the distant office end of the interoffice trunk and connected cord circuit, and coin box control relays associated with the local office end of said coin control trunk and controllable by said first relays over said coin control trunk.

3. In a telephone exchange system, a local office, a calling line terminating therein and having a coin box thereon, a toll operator's position, a toll trunk for connecting said local office with said operator's position, cord circuits and coin control keys common thereto at said operator's position, a talking key for each cord circuit for associating said coin control keys with said cord circuit, and coin control relays associable with the toll trunk for controlling said coin box and controllable by said coin control keys over the trunk and connected cord circuit.

4. In a telephone exchange system, a local office, a calling line terminating therein and having a coin box thereon, a toll operator's position, a toll trunk for connecting said local office with said operator's position, cord circuits and coin collect and refunding keys common thereto at said operator's position, a talking key for each cord circuit for associating said coin keys with said

cord circuit, and a sensitive relay and a marginal relay associable with the toll trunk for controlling said coin box and controllable selectively by said coin collect and refund keys over a talking conductor of said trunk and connected cord circuit.

5. In a telephone exchange system, a local office, a calling line terminating therein and having a coin box thereon, a toll office, means including an interoffice toll trunk for connecting said offices, an operator's position at said toll office having cord circuits for connection with said toll trunk and coin control keys, a talking key for each cord circuit for associating said coin control keys with said cord circuit, a coin control trunk extending from the toll office to the local office, coin control relays associated with the toll office end of said coin control trunk and controllable by said coin control keys over the toll office end of the toll trunk and connected cord circuit, and coin box control relays associated with the local office end of said coin control trunk and controllable by said first relays over said coin control trunk.

6. In a telephone exchange system, a local office, a calling line terminating therein and having a coin box thereon, a toll office, means including an interoffice toll trunk for connecting said offices, an operator's position at said toll office having cord circuits for connection with said toll trunk and coin control keys, a talking key for each cord circuit for associating said coin control keys with said cord circuit, a coin control trunk extending from the toll office to the local office, coin control relays associated with the toll office end of said coin control trunk and controllable by said coin control keys over a talking conductor of the toll office end of said toll trunk and connected cord circuit, and coin box control relays associated with the local office end of said coin control trunk and controllable by said first relays over said coin control trunk.

7. In a telephone exchange system, a local office, a calling line terminating therein and having a coin box thereon, a toll office, means including an interoffice toll trunk for connecting said offices, an operator's position at said toll office having cord circuits for connection with said toll trunk and coin collect and refund keys, a talking key for each cord circuit for associating said coin keys with said cord circuit, a coin control trunk extending from the toll office to the local office, a marginal relay and a sensitive relay associated with the toll office end of said coin control trunk and controllable selectively by said coin collect and coin refund keys over the toll office end of the toll trunk and connected cord circuit, and coin box control relays associated with the local office end of said coin control trunk and controllable by said first relays over said coin control trunk.

8. In a telephone exchange system, a local office, a calling line terminating therein and having a coin box thereon, a toll office, means including an interoffice toll trunk for connecting said offices, an operator's position at said toll office having cord circuits for connection with said toll trunk and coin collect and refund keys, a talking key for each cord circuit for associating said coin keys with said cord circuit, a coin control trunk extending from the toll office to the local office, a marginal relay and a sensitive relay associated with the toll office end of said coin control trunk and controlled selectively by said coin collect and coin refund keys over

a talking conductor of the toll office end of said toll trunk and connected cord circuit, and coin box control relays associated with the local office end of said coin control trunk and controllable by said first relays over said coin control trunk.

9. In a telephone exchange system, a local office, a calling line terminating therein and having a coin box thereon, a toll office, means including an interoffice toll trunk for connecting said offices, an operator's position at said toll office having cord circuits for connection with said toll trunk and coin control keys, a talking key for each cord circuit for associating said coin control keys with said cord circuit, a coin control trunk extending from the toll office to the local office, coin control relays associated with the toll office end of said coin control trunk and controllable by said coin control keys over the toll office end of the toll trunk and connected cord circuit, coin box control relays associated with the local office end of said coin control trunk and controllable by said first relays over said coin control trunk, sources of tone current and means controlled by said coin box control relays for selectively connecting said sources of tone current to said toll trunk for signaling said operator when coin box control current has been applied to said coin box.

10. In a telephone exchange system, a local office, a calling line terminating therein and having a coin box thereon, a toll office, means including an interoffice toll trunk for connecting said offices, an operator's position at said toll office having cord circuits for connection with said toll trunk and coin collect and refund keys, a talking key for each cord circuit for associating said coin keys with said cord circuit, a coin control trunk extending from the toll office to the local office, a sensitive relay and a marginal relay associated with the toll office end of said coin control trunk and controllable selectively by said coin collect and coin refund keys over the toll office end of the toll trunk and connected cord circuit, coin box control relays associated with the local office end of said coin control trunk and controllable by said first relays over said coin control trunk, a source of low tone current and a source of high tone current, means for connecting said source of low tone current to said toll trunk for signaling said operator when one of said coin box control relays has responded to connect coin collect current to said coin box and means for connecting said source of high tone current to said toll trunk for signaling said operator when the other of said coin box control relays has responded to connect coin refund current to said coin box.

11. In a telephone exchange system, a local office, calling lines terminating therein, each having a coin box thereon, a toll office, means including a plurality of interoffice toll trunks for connecting said offices, an operator's position at said toll office having cord circuits for connection with said toll trunks and coin control keys, a talking key for each cord circuit for associating said coin control keys with said cord circuit, a coin control trunk common to said toll trunks extending from the toll office to the local office, coin control relays associated with the toll office end of said coin control trunk and controllable by said coin control keys over the toll office ends of the toll trunks and interconnected cord circuits, coin box control relays associated with the local office end of said coin control trunk, means operable upon the connection of a cord circuit with

any one of said toll trunks and the operation of a coin control key for establishing a circuit over said coin control trunk between the toll office end of said connected toll trunk and the local office end thereof, and means controlled by the coin control relays for selectively operating the coin box control relays over said coin control trunk.

12. In a telephone exchange office, a local office, calling lines terminating therein each having a coin box thereon, a distant office, means including a plurality of interoffice trunks for connecting said offices, an operator's position at said distant office having cord circuits for connection with said interoffice trunks and coin control keys, a talking key for each cord circuit for associating said coin control keys with said cord circuit, a coin control trunk common to said interoffice trunks extending from the distant office to the local office and terminating at each end in a finder switch, coin control relays associated with the distant end of said coin control trunk and controllable by said coin control keys over the distant office ends of said interoffice trunks and interconnected cord circuits, coin box control relays associated with the local office end of said coin control trunk, means operable upon the connection of a cord circuit to any one of said interoffice trunks and the operation of a coin control key for synchronously operating said finder switches to establish a circuit over said coin control trunk between the distant office and local office ends of said connected interoffice trunk, and means controlled by the coin control relays of the coin control trunk for selectively operating the coin box control relays over said coin control trunk.

13. In a telephone exchange system, a local office, calling lines terminating therein, each having a coin box thereon, a toll office, means including a plurality of interoffice toll trunks for connecting said offices, an operator's position at said toll office having cord circuits for connection with said toll trunks and coin control keys, a talking key for each cord circuit for associating said coin control keys with said cord circuit, a coin control trunk common to said toll trunks extending from the toll office to the local office and terminating at each end in a finder switch, coin control relays associated with the toll office end of said coin control trunk and controllable by said coin control keys over the toll office ends of said toll trunks and interconnected cord circuits, coin box control relays associated with the local office end of said coin control trunks, means operable upon the connection of a cord circuit to any one of said toll trunks and the operation of a coin control key for synchronously operating said finder switches to establish a circuit over said control trunk between the toll office and the local office ends of said connected toll trunk, and means controlled by the coin control relays of the coin control trunk for selectively operating the coin box control relays over said coin control trunk.

14. In a telephone exchange system, a local office, calling lines terminating therein each having a coin box thereon, a toll office, means including a plurality of interoffice toll trunks for connecting said offices, an operator's position at said toll office having cord circuits for connection with said toll trunks and coin control keys, a talking key for each cord circuit for associating said coin control keys with said cord circuit, a coin control trunk common to said toll trunks extending from the toll office to the local office and terminating at each end in a finder switch,

coin control relays associated with the toll office end of said coin control trunk and controllable by said coin control keys over the toll office ends of said toll trunks and interconnected cord circuits, coin box control relays associated with the local office end of said coin control trunks, means operable upon the connection of a cord circuit to any one of said toll trunks and the operation of a coin control key for operating the finder switch at the toll office end of said coin control trunk to hunt for the toll office end of the toll trunk to which the operator has connected a cord circuit, means for simultaneously operating the finder switch at the local office end of said coin control trunk to select the local office end of the same toll trunk whereby a circuit is established over said control trunk between the toll office and local office ends of said connected toll trunk, and means controlled by the coin control relays of the coin control trunk for selectively operating the coin box control relays over said coin control trunk.

15. In a telephone exchange system, a local office, calling lines terminating therein each having a coin box thereon, a toll office, means including a plurality of interoffice toll trunks for connecting said offices, an operator's position at said toll office having cord circuits for connecting with said toll trunks and coin control keys, a talking key for each cord circuit for associating said coin control keys with said cord circuit, a plurality of coin control trunks common to said toll trunks extending from the toll office to the local office, coin control relays associated with the toll office end of each of said coin control trunks and controllable by said coin control keys over the toll office ends of said toll trunks and interconnected cord circuits, coin box control relays associated with the local office end of each of said coin control trunks, means operable upon the connection of a cord circuit to any one of

said toll trunks and the operation of a coin control key for selecting an idle one of said coin control trunks and for selectively operating the coin control relays thereof, and means controlled by the coin control relays of the selected coin control trunk for controlling the coin box control relays of said trunk over said trunk.

16. In a telephone exchange system, a local office, calling lines terminating therein each having a coin box thereon, a toll office, means including a plurality of interoffice toll trunks for connecting said offices, an operator's position at said toll office having cord circuits for connecting with said toll trunks and coin control keys, a talking key for each cord circuit for associating said coin control keys with said cord circuit, a plurality of coin control trunks common to said toll trunks extending from the toll office to the local office, and terminating at each end in a finder switch, coin control relays associated with the toll office end of each of said coin control trunks and controllable by said coin control keys over the toll office ends of said toll trunks and interconnected cord circuits, coin box control relays associated with the local office end of each of said coin control trunks, means operable upon the connection of a cord circuit to any one of said toll trunks and the operation of a coin control key for selecting an idle one of said coin control trunks to cause the finder switch of the toll office end thereof to hunt for the toll office end of the toll trunk to which the operator has connected, to simultaneously cause the finder switch at the local office end thereof to select the local office end of the same toll trunk, and to selectively operate the coin control relays of the selected coin control trunk, and means controlled by the coin control relays for controlling the coin box control relays over said coin control trunk.

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