

April 5, 1927.

S. B. WILLIAMS ET AL
TELEPHONE EXCHANGE SYSTEM

Filed March 29, 1924

8 Sheets-Sheet 1

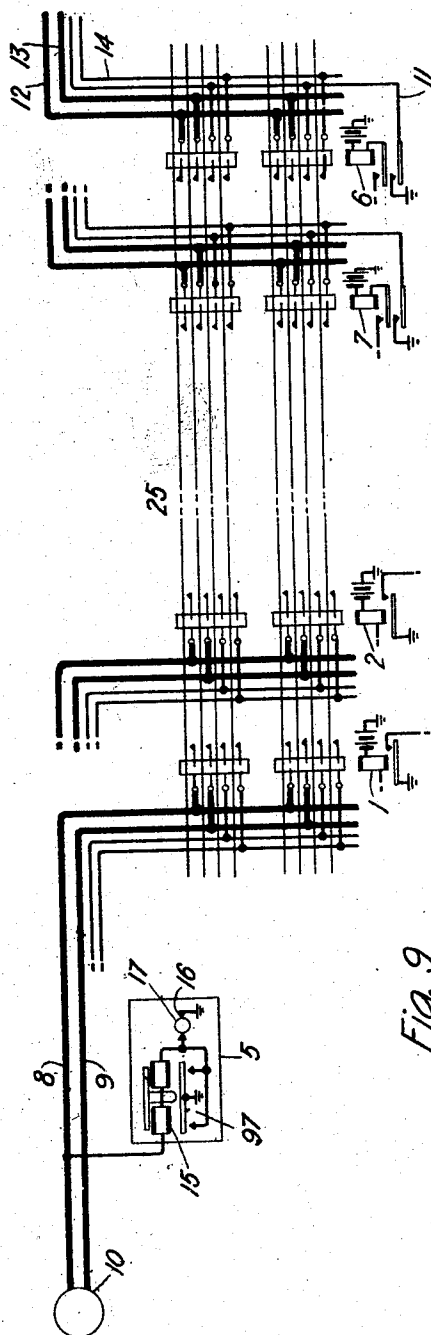


Fig. 9

Fig. 1	Fig. 2	Fig. 3	Fig. 4	Fig. 5	Fig. 6	Fig. 7
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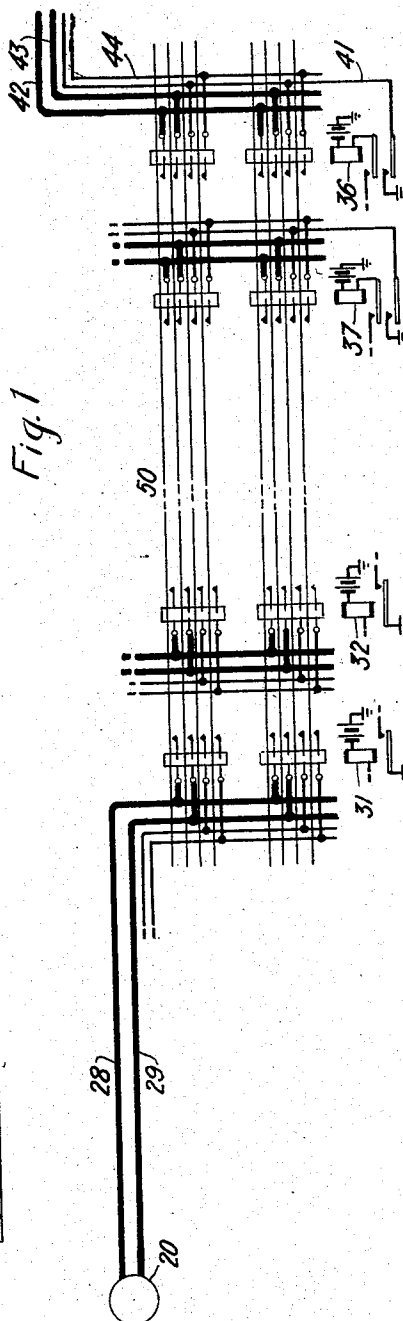


Fig. 1

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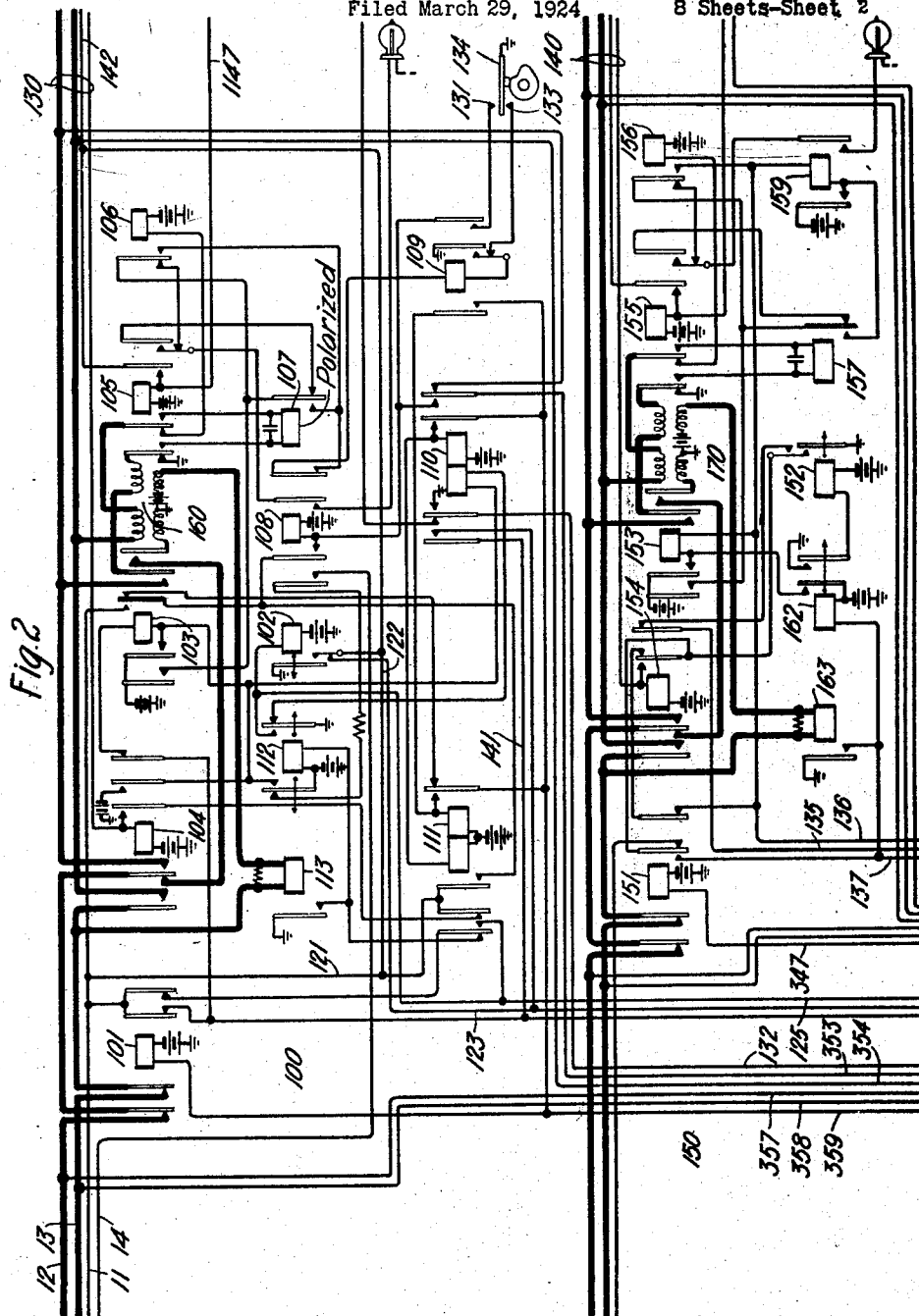
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TELEPHONE EXCHANGE SYSTEM

1,623,769

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8 Sheets-Sheet 2



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TELEPHONE EXCHANGE SYSTEM

1,623,769

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8 Sheets-Sheet 3

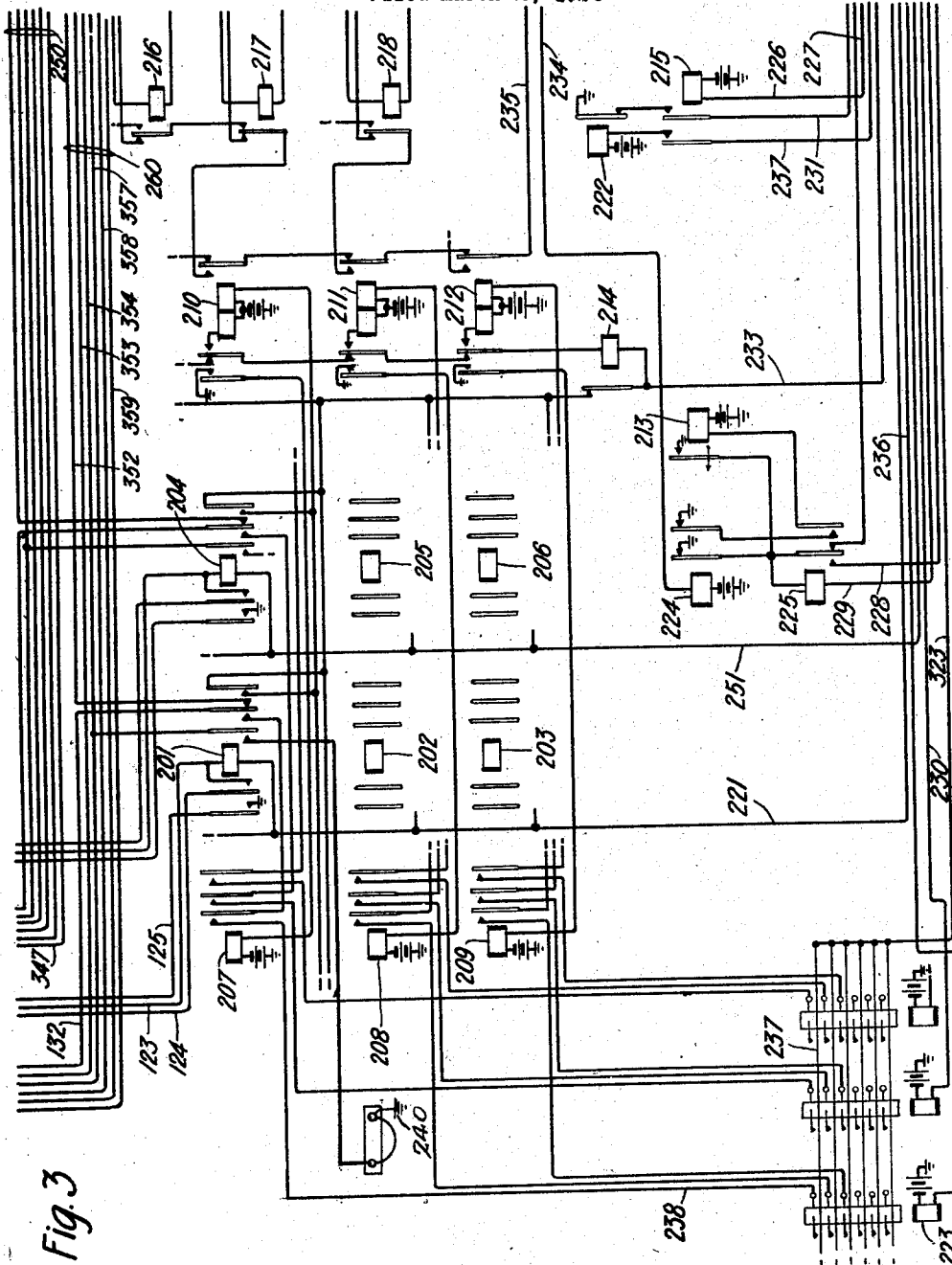


Fig. 3

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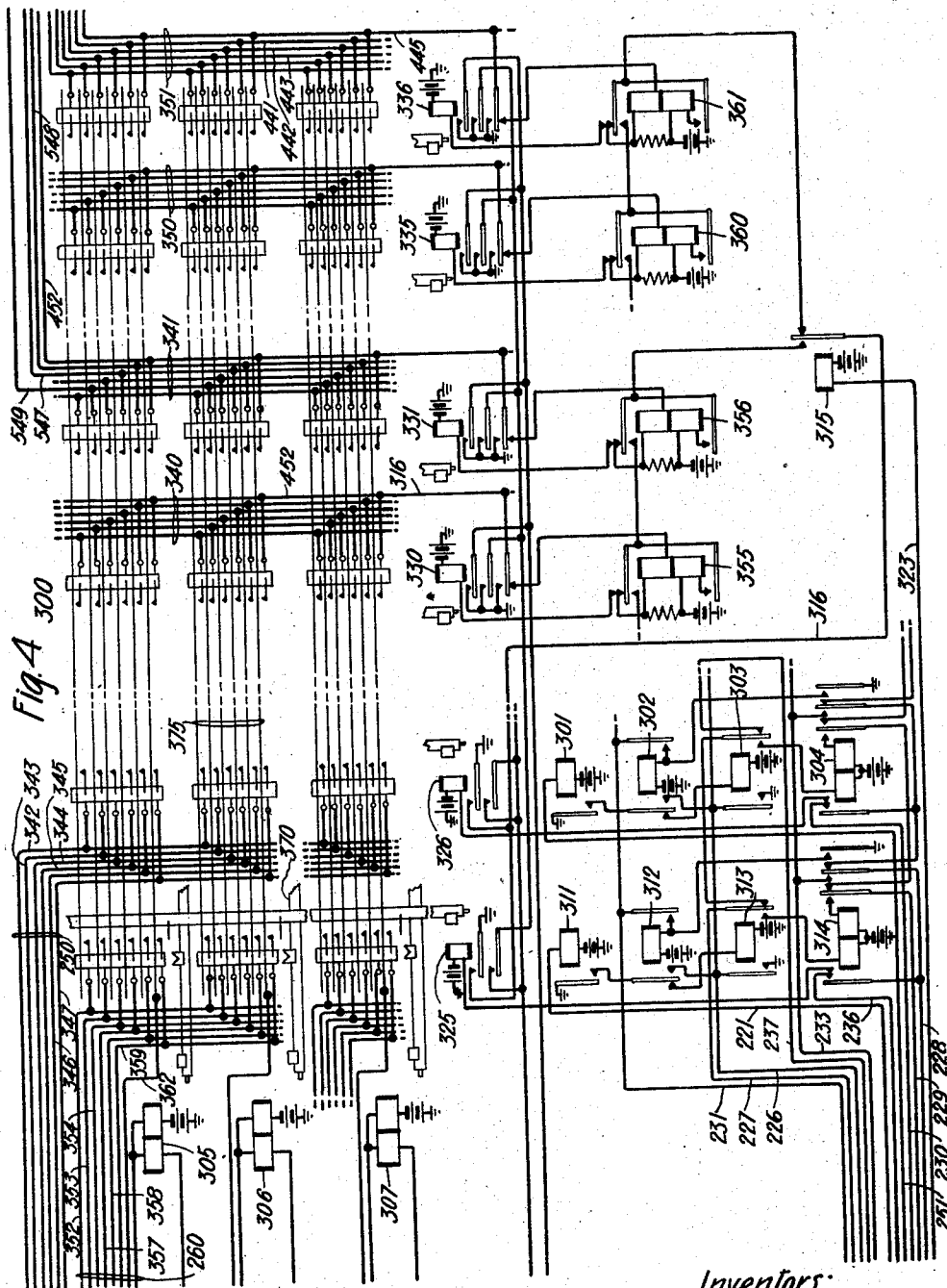
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TELEPHONE EXCHANGE SYSTEM

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8 Sheets-Sheet 4



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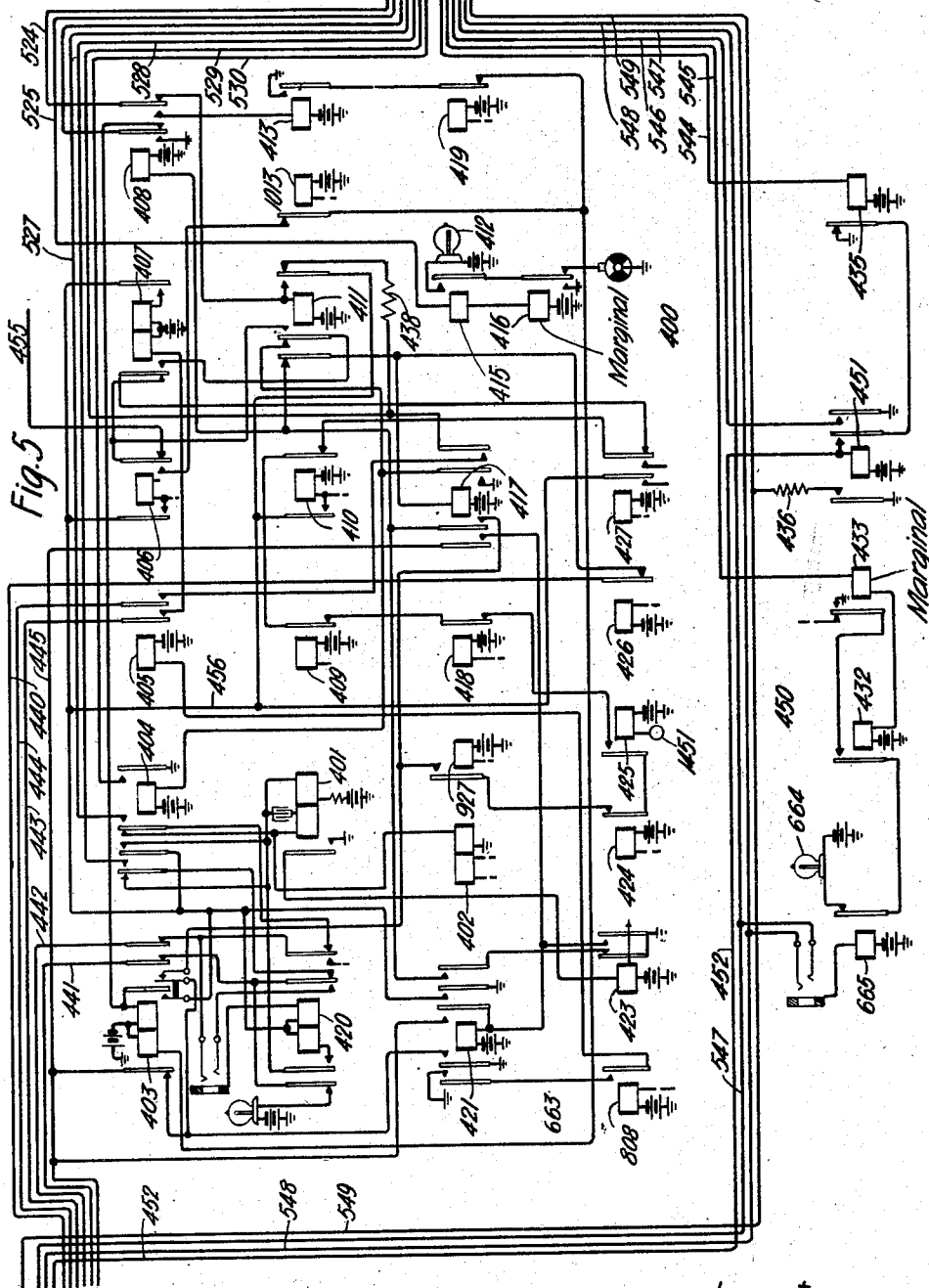
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TELEPHONE EXCHANGE SYSTEM

Filed March 29, 1924

8 Sheets-Sheet 5



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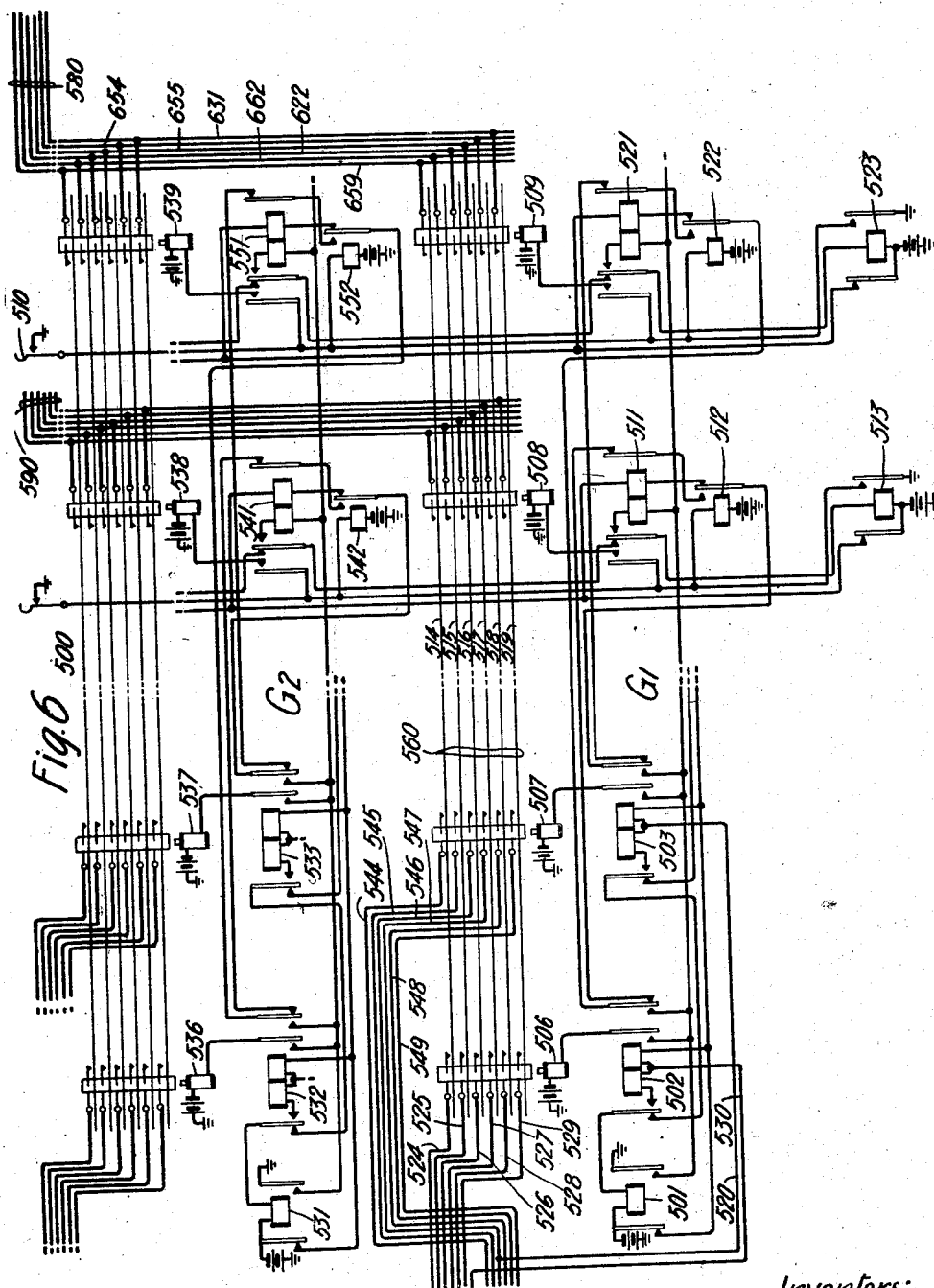
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8 Sheets-Sheet 6



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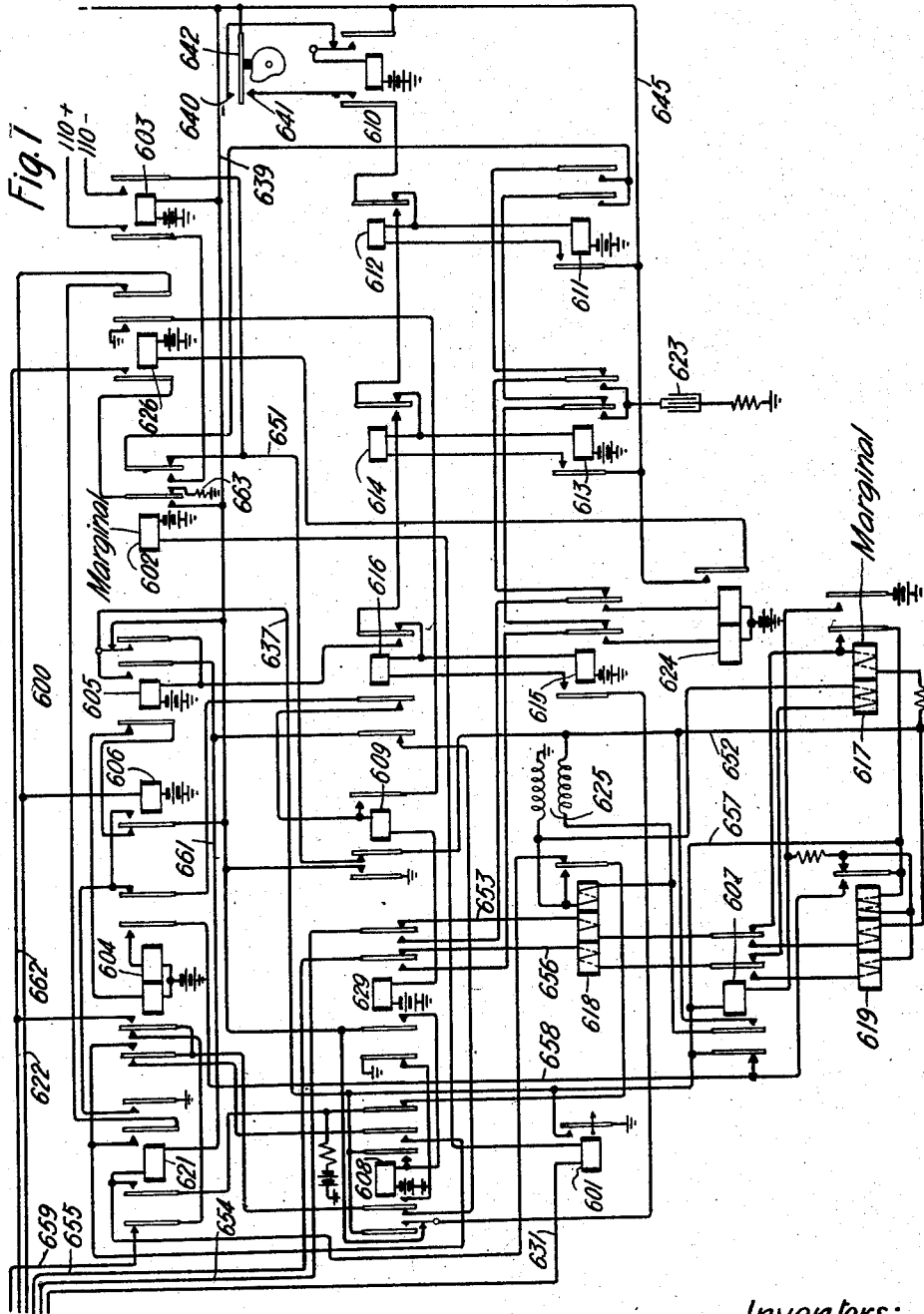
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8 Sheets-Sheet 7



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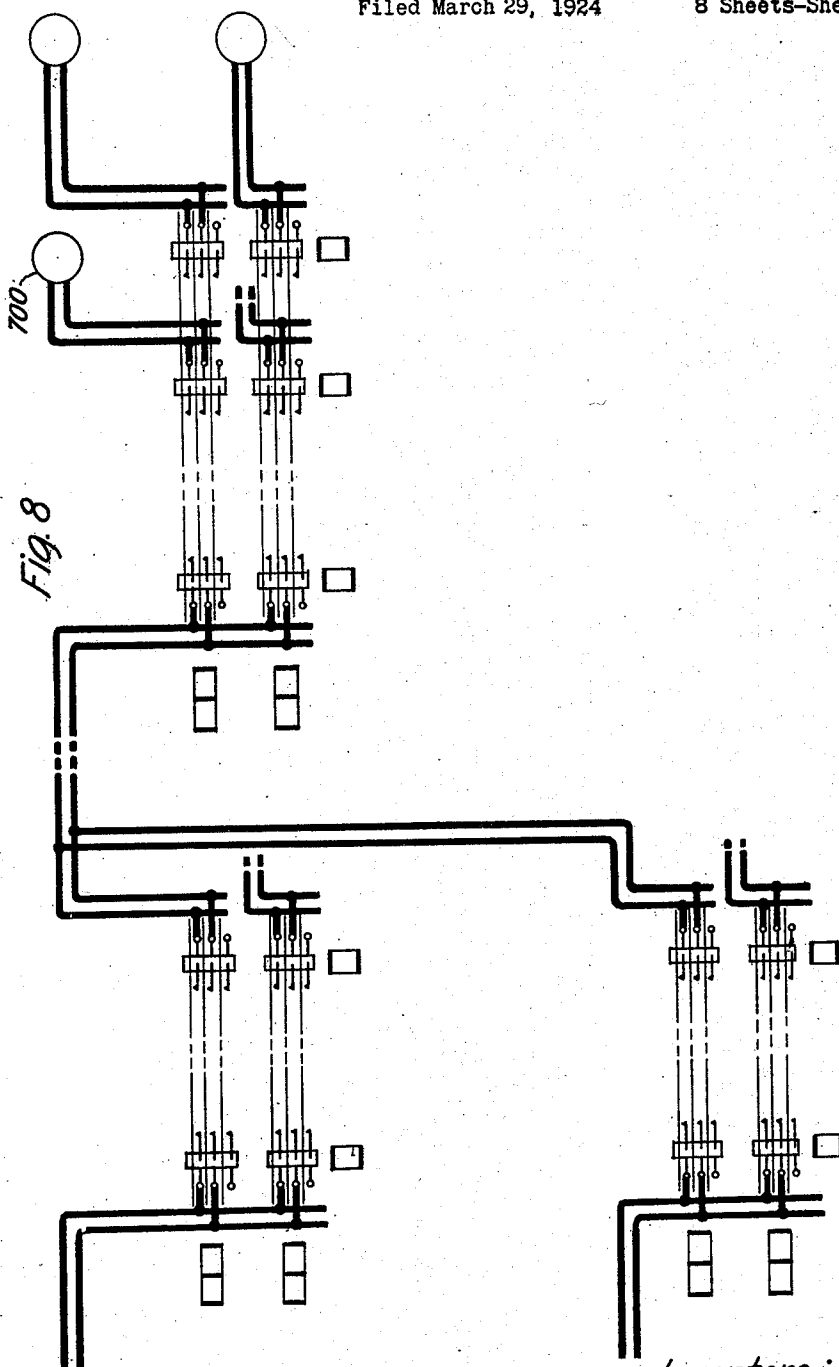
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TELEPHONE EXCHANGE SYSTEM

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8 Sheets-Sheet 8



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UNITED STATES PATENT OFFICE.

SAMUEL B. WILLIAMS, OF BROOKLYN, NEW YORK, AND EARL S. GIBSON, OF RIDGEWOOD, NEW JERSEY, ASSIGNORS TO WESTERN ELECTRIC COMPANY, INCORPORATED, OF NEW YORK, N. Y., A CORPORATION OF NEW YORK.

TELEPHONE-EXCHANGE SYSTEM.

Application filed March 29, 1924. Serial No. 702,732.

This invention relates to a telephone exchange system and more particularly to telephone exchange systems in which connections are established by automatic switches under the control of a calling subscriber.

An object of this invention is to provide in an automatic telephone exchange system of large capacity an improved call charging system arranged to utilize a minimum of central office apparatus which will operate efficiently.

A feature of this invention consists in providing a sender mechanism commonly available to calling subscribers' lines either equipped or not equipped with coin box mechanism for controlling the establishment of a connection to a called subscriber's line and arranged to arrest the establishment of the connection when the call originates on a coin subscriber's line until after the deposit of a coin in the coin box associated with the calling subscriber's line.

Another feature of this invention consists in providing means individual to each district selector switch associated with the calling subscriber's lines equipped with coin box mechanism, for causing a sender mechanism normally arranged to function on a non-coin basis to function on a coin basis when associated with such a calling subscriber's line. It is understood that this feature of the invention is not limited to lines equipped with charging means actuated by the deposit of a coin but it may be used with calling subscriber's lines equipped with various kinds of charging means such as a subscriber's charge meter similar to the coin box mechanism herein disclosed and actuated by the pressing of a key instead of the deposit of a coin.

Still another feature consists in providing a minimum number of coin control circuits commonly available to any of a plurality of sender mechanisms, any one of which latter may be employed to associate a coin control circuit with a calling subscriber's line.

A further feature of this invention consists in providing a call charging system wherein an idle one of a plurality of coin control circuits commonly available to a plurality of calling subscriber's coin lines is connected to a calling subscriber's coin line by means of one of a plurality of sender

mechanisms before the establishment of the talking connection and an idle one of said plurality of said coin control circuits is connected to one of said calling subscribers' coin lines after the disestablishment of the talking connection by means of a simple coin circuit instead of a complicated sender mechanism.

A still further feature of this invention consists in providing a sender selector switch common to the calling subscribers' coin and non-coin lines arranged to select a sender mechanism for the purpose of controlling the establishment of a talking connection and to select a special coin circuit upon the disestablishment of the talking connection when the calling line used is provided with a coin box.

Various other novel features will be observed from a consideration of the following description of this system taken in connection with the appended drawings.

The upper portion of Fig. 1 represents a line switch 25 arranged to exclusively connect the calling subscriber's coin line 10 to a district selector switch circuit arranged for coin service, such as shown at 100 in Fig. 2. The lower portion of Fig. 1 represents the line switch 50 arranged to connect non-coin subscriber's station 20 to a district selector switch circuit arranged for non-coin service such as shown at 150 in Fig. 2.

In the upper portion of Fig. 2 a district selector switch circuit arranged for coin service is disclosed in part at 100. In the lower portion of Fig. 2, represented by numeral 150, a district selector switch circuit arranged for non-coin service is partially disclosed.

Figs. 3 and 4 taken together represent a sender selector arranged to select either a recording sender or a coin control connecting circuit.

Fig. 5 illustrates a portion of a recording sender 400 of substantially the same type as the recording sender illustrated and described in the patent to S. B. Williams, No. 1,517,331, granted Dec. 2, 1925, including in schematic form only such portions of the circuit as are necessary to an understanding of this invention.

It will be observed that certain of the apparatus in this figure, necessarily shown to function with that portion of the sender in-

volved in this invention, bears the same indicating numerals as borne by similarly operating apparatus in the aforesaid patent. The lower portion of Fig. 5 indicated by numeral 450 represents a special coin sender containing a minimum amount of apparatus arranged to be connected only to calling subscriber's lines equipped with coin boxes in the place of the complicated recording sender 400 for the purpose of collecting or returning a coin after the termination of a successful connection to the called subscriber's line.

Fig. 6 represents a coin control connector arranged to connect an idle one of a plurality of coin control circuits to one of a plurality of either recording senders or special coin senders.

Fig. 7 represents a coin control circuit arranged to control the recording sender and the disposition of a coin inserted in the coin box of a coin subscriber's line.

Fig. 8 shows diagrammatically a district switch in which the district circuit of Fig. 2 terminate, a connector switch and subscribers' lines terminating in the connector switch.

In a system of this nature, a coin subscriber's line terminates in a line switch, the trunks outgoing from which terminate exclusively in district selector switch circuits arranged for coin service. A non-coin subscriber's line terminates in a line switch, the trunks outgoing from which terminate exclusively in district selector switch circuits arranged for non-coin service. Both the coin and non-coin service district selector switch circuits have access to a common district selector switch which extends a connection to the called party through a subsequent train of switches in the same manner as described in the patent to S. B. Williams, No. 1,517,331, granted Dec. 2, 1924.

It is thought that the invention will be best understood from a detail consideration of the circuits disclosed and the manner in which they function. It will first be assumed that a subscriber whose line 10 is equipped with a coin box initiates a call by removing his receiver from the switchhook.

When the subscriber takes the receiver from the hook at substation 10, the vertical magnets 1 and 6 are operated and the leads 8 and 9 from substation 10 are connected by conductors 12 and 13 to coin district selector circuit 100 in a manner well known in the art and described in the patent to S. B. Williams, No. 1,517,331.

Vertical magnet 6 in operating completes a circuit from ground on the front contact of magnet 6, conductor 11, conductor 121, conductor 122, back contact of slow release relay 102, conductor 123, winding of relay 201, conductor 221 to battery through the winding of relay 311. Relays 201 and 311

operate in this circuit. Relay 201 in operating provides a locking circuit for itself and relay 311, through its inner left front contact, conductor 124, inner right back contact of relay 101 to ground over conductor 11. Relay 201 in operating completes a circuit from battery, winding of slow release relay 102, conductor 125 to ground on its outer left front contact. Relay 102 operates and at its left front contact provides a circuit over conductor 11 for maintaining the line switch 25 operated after the line switch vertical magnets 1 and 6 are restored in the manner described in the aforesaid patent to S. B. Williams. Relay 102 in operating also opens the initial energizing circuit of relay 201.

Relay 311 in operating causes the sender selector to connect an idle sender to the coin district selector circuit 100 in the following manner: at its front contact relay 311 closes an obvious circuit for operating relay 313. Relay 313 operates and closes a circuit from battery, winding of relay 215, conductor 226 to ground on the left front contact of relay 313, operating relay 215. Relay 313 at its right front contact closes a circuit for operating group relay 314, from battery, left winding of relay 314, right front contact of relay 313, conductor 227, inner back contact of relay 225 to ground on the inner back contact of relay 224. Relay 314 in operating completes at its outer right front contact an obvious circuit for operating relay 312. Relay 312 operates locks over its right contact, conductor 231, inner left contact of relay 215 to ground at the contact of relay 222, and at its left back contact opens the energizing circuit for relay 313 which deenergizes.

When relay 314 operates it completes a circuit for holding itself energized and for operating relay 225, prior to the deenergization of relay 313, from battery, through its right winding and inner right front contact, conductor 229, winding of relay 225 to ground on the inner back contact of relay 224. The operation of relays 314 and 225 by holding open the energizing circuits of all other vertical group relays similar to relay 304 at either the inner right back contact of relay 314 or at the back contact of relay 225 prevents the possibility of any other calling line associated with any other vertical group from attaching itself to a sender. With relays 314 and 225 operated, a circuit is completed from battery, winding of multi-contact relay 223, lead 236, outer left front contact of relay 314, conductor 228, inner right front contact of relay 225 to ground at the inner back contact of relay 224. Relay 223 operates but performs no useful function at this time.

When relay 313 deenergizes it opens the initial energizing circuit of relay 314 and

the energizing circuit for relay 215. Relay 215 does not release due to the operation of relay 312, providing a holding circuit for relay 215 before relay 313 can release from battery, winding of relay 215, conductor 226, left front contact of relay 312 to ground on the front contact of relay 311. The re-operation of relay 215 provides a locking circuit for relay 312, traceable from battery, winding and right front contact of relay 312, conductor 231, front contact of relay 215 to ground at the back contact of relay 222.

The continued operation of relay 312 by holding open the energizing circuit for relay 313 at its back contact, prevents at this time the possibility of any other district selector circuit in the same vertical group as district selector 100 from being connected to an idle sender.

When relays 314 and 225 are operated, a circuit is completed for operating sender vertical magnet 325. This circuit may be traced from battery, winding of vertical magnet 325, inner left front contact of relay 314, conductor 228, inner front contact of relay 225 to ground at the back contact of relay 224. Magnet 325 operates and rotates its associated vertical rod to prepare the switch contacts of all lines common to vertical magnet 325 for connection with a horizontal link.

Relays 314 and 225 in operating also complete a circuit for operating an idle horizontal group relay, such as relay 210, in a circuit which may be traced from battery, right winding of relay 210, outer right front contact of relay 201, back contact of relay 214, conductor 233, middle right front contact of relay 314, conductor 228, front contact of relay 225 to ground on the back contact of relay 224. Relay 210 operates and completes a locking circuit for itself from battery, through its left winding and inner left front contact, the left inner back contacts of other horizontal group relays 211 and 212 in series, winding of relay 214, conductor 233 to ground, as previously described. Relay 214 operates in this circuit and attracts its armature, opening the initial energizing circuits of all horizontal group relays thereby preventing the operation at this time of a horizontal magnet in any horizontal group other than in the horizontal group associated with and controlled by horizontal group relay 210. Relay 210 in operating also closes at its outer left front contact an obvious circuit for operating relay 207. Relays 223 and 207 which are operated perform no useful function at this time.

When relay 225 was first operated, a circuit was completed from battery, winding of slow release relay 213, outer right front contact of relay 225 to ground at the outer right back contact of relay 224. Relay 213

operates and in so doing provides an additional holding circuit for relays 314 and 225 on its front contact.

The operation of sender vertical magnet 325 closes a circuit for operating trunk vertical magnet 336. This circuit may be traced from battery, winding of magnet 336, back contact of distributing relay 361, back contact of relay 315, conductor 316 to ground at the front contact of sender vertical magnet 325. Trunk vertical magnet 336 operates and rotates its associated vertical rod to prepare the contacts of all outgoing trunks associated with trunk vertical magnet 336 for connection to a horizontal link.

When trunk vertical magnet 336 operates, a circuit is completed for operating relay 224. This circuit may be traced from battery, winding of relay 224, conductor 234 to ground on the innermost front contact of magnet 336. Relay 224 in operating opens the energizing circuit of slow release relay 213. The slow release relay is so constructed as to release so slowly as to provide on its front contact holding ground for relay 225 for a sufficient length of time after the operation of relay 224 to assure the operation of the first idle horizontal magnet in the group of horizontal magnets controlled by horizontal group relay 210.

The first idle horizontal magnet 306 operates in a circuit from battery, right winding of horizontal magnet 306, back contact of horizontal relay 217, right front contact of horizontal group relay 210, right back contacts of other horizontal group relays in series, conductor 235, lower front contact of sender vertical magnet 325 to ground on the middle front contact of vertical magnet 336. Horizontal magnet 306 in operating rotates its associated horizontal rod so as to connect the conductors of the horizontal link 375 with the contacts terminating in circuit connector 260 and with the contacts of register sender connecting circuit 351, thereby connecting district selector circuit 100 to the recording sender 400.

Relay 224 in operating opens the initial holding circuit for energizing relays 314 and 225 at its innermost back contact. Consequently, when relay 213 fully releases the energizing circuit through the right winding of relay 314 and the winding of relay 225 is opened at the front contact of relay 213, thereby releasing relays 225 and 314. Relay 314 in deenergizing opens the circuit for operating sender vertical magnet 325 which releases. Sender vertical magnet 325 in releasing opens the operating circuit of trunk vertical magnet 336 causing it to release. Relay 314 in releasing also opens the energizing circuits of relays 210, 214 and 223 causing them to release. Sender vertical magnet 336 in releasing in turn releases relay 224. Relay 224 in releasing completes a

circuit from battery winding of relay 222 outer left front contact of relay 213, conductor 237, back contact of relay 303, back contact of relay 313, conductor 227 back contact of relay 225 to ground on the back contact of relay 224. Relay 222 operates and at its back contact opens the holding circuit of relay 312 which releases and in turn releases relay 215. Relay 215 in releasing opens at its outer front contact the energizing current of relay 222 causing it to release. It is to be noted that all relays controlling the operation of the vertical magnet are now released.

Immediately upon the operation of horizontal magnet 306 connecting the district selector circuit 100 to the sender 400, a circuit is completed for operating pulsing relay 401 of the sender from battery, right winding of pulsing relay 401, outer left back contact of relay 404, inner right back contact of relay 420, inner right back contact of relay 403, conductor 441, contacts and conductor of horizontal link 375 of switch 300, conductor 358, conductor 13, contacts and horizontal link of line switch 25, conductor 9, substation 10, conductor 8, contacts and horizontal link of line switch 25, conductor 12, conductor 357, contacts and conductor of link 375 of sender selector switch 300, conductor 442, outer right back contact of relay 403, outer right back contact of relay 420, innermost back contact of relay 404 to ground through the right winding of retardation coil 402. Relay 401 operates in this circuit and completes at its front contact an obvious circuit for operating slow release relay 423. Relay 423 in operating completes at its outer right front contact an obvious circuit for operating relay 421. Relay 421 in operating completes a circuit for holding horizontal magnet 306 operated after the deenergization of sender vertical magnet 336, traceable from battery, windings of horizontal magnet 306, winding of relay 217, contacts and horizontal link conductor 375 of sender selector switch 300, conductor 445, left inner back contact of relay 403 to ground on the inner left front contact of relay 421. Relay 217 does not immediately operate in this circuit but waits until after relay 210 releases and opens the shunt circuit around the left winding of relay 306 and the winding of relay 217.

In accordance with the structure of sender selector switch as described in the aforesaid patent to S. B. Williams, No. 1,517,331, while the horizontal magnet 306 is operated the district selector switch circuit 100 will be held connected to the sender 400 despite the release of vertical magnets 325 and 336. The release of vertical magnets 325 and 336 restore their associated vertical rods to normal.

Upon the operation of trunk vertical mag-

net 336 a circuit is completed for operating relay 101 from battery, winding of relay 101, conductor 359, contacts and conductor of link 375 of sender selector switch 300, conductor 445 to ground on the lowermost front contact of trunk vertical magnet 336. Upon the operation of relay 401 ground on the inner left front contact of relay 421 is connected to conductor 445 thereby providing holding ground for holding relay 101 operated when trunk vertical magnet 336 releases. With relay 101 operated a circuit is completed for operating slow release relay 112 from battery, winding of relay 112, outer left back contact of relay 111, outer right front contact of relay 101 to ground on the front contact of relay 102. Relay 101 in operating opens at its inner right back contact the holding circuit for relays 201 and 311 causing these relays to release. Relay 201 in deenergizing opens at its outer left front contact the operating circuit for slow release relay 102. However, since relay 102 is slow releasing, relay 112 will operate and complete an obvious circuit for energizing relay 102 before it can release in order to keep ground continuously on lead 11 for holding the line switch operated.

The sender involved in this invention is normally arranged for flat-rate service and when so arranged proceeds to control the establishment of a desired connection in the manner described in the patent to S. B. Williams, No. 1,517,331, except that the circuit for connecting a line marker (not shown) to the sender is modified to the extent that the circuit is traced through the back contacts of several relays which are not shown in the sender of the above mentioned patent and which energize only when a coin line is calling.

When it is desired to use the selector for coin subscribers' calling lines ground 240 is connected to the inner right front contact of relay 201 of each coin district selector circuit associated with the calling coin lines. As will hereinafter be explained ground on the inner right front contact of relay 201 operates a relay in the sender 300 causing the establishment of the talking connection to be arrested until after a satisfactory preliminary test for a coin in the calling coin subscriber's coin box has been made.

When the sender is connected to the calling line, a circuit is completed before relay 201 releases from ground 240 on the inner front contact of relay 201, conductor 354, contacts and conductor of horizontal link 375 of sender selector 300, conductor 443, inner back contact of relay 405 to battery through the left winding of relay 407. Relay 407 operates and completes a locking circuit for itself through its right winding and right front contact to ground on the middle right front contact of relay 421.

Relay 407 operates and attracts its left armature holding open the circuit for operating the line marker sender connector (not shown) thereby arresting the establishment of the talking connection until after the operation of relay 411 which is operated only as the result of a satisfactory preliminary coin test.

When the sender is connected to the calling line, the calling subscriber receives a dial tone in the well known manner notifying him that the sender is ready to receive the dial pulses. The subscriber thereupon dials and the pulses are registered on the sender register relays (not shown) in the same manner as described and illustrated in the aforesaid patent to S. B. Williams.

When the thousands series of impulses are registered, thousand series register relay 808 is operated as described in said above mentioned patent and relay 405 is operated in a circuit from battery, winding of relay 405, front contact of relay 808 to ground on the outer left front contact of holding relay 421. Relay 405 in operating completes a circuit for operating a sender connector. A district marker is then attached to the sender and district selection is accomplished, whereupon the district marker and the sender connector are released. The operation of the foregoing switches, only certain ones of which are diagrammatically shown, is illustrated and described in detail in the aforesaid patent of S. B. Williams. A description of the operation of the foregoing switches is not believed to be essential to an understanding of this invention, and hence no description is given in this application. The release of the district marker, as described in said foregoing patent, connects ground to lead 1451, Fig. 5, thereby completing a circuit for operating relay 425. When the unit series of impulses are registered, control relay 927, Fig. 5, of the units register relays is operated, as described in the aforesaid patent.

Preliminary coin test.—Before the sender may proceed any further in establishing the connection, it is necessary that a preliminary coin test be made in the sender to ascertain whether the subscriber has deposited the proper coin in the coin slot. Assuming that the sender is completing a local connection which does not involve the operation of class control relays, a circuit is closed at this time for operating relay 404 from battery, winding of relay 404, inner left back contact of relay 411, left front contact of relay 407, back contact of relay 427, back contact of relay 410, back contact of relay 409, back contact of relay 418, front contact of relay 425, back contact of relay 424, front contact of units register control relay 927, outer left back contact of relay 403, to ground on the inner left front contact of relay 421.

Relay 404 operates and in so doing disconnects the leads 441 and 442 from the recording circuit and extends them to the coin control connector 500 through leads 528 and 527 respectively. Relay 404 in operating also provides a holding circuit for pulsing relay 401. This circuit may be traced from battery, winding of relay 401, middle left front contact of relay 404 to ground on the middle right front contact of holding relay 421. The operation of relay 404 also completes a circuit for energizing the start relay 502 of the coin control connector switch 500. The start relays of the coin control connector switch 500 are arranged in a number of groups, group G_1 comprising start relays 502 and 503 and group G_2 comprising start relays 532 and 533. The senders in an exchange are divided into groups corresponding in number with the number of groups of start relays, each group of senders corresponds to a particular group of start relays and each sender in a group is arranged to control the operation of a particular start relay of a corresponding group of start relays.

Associated with each start relay is a sender vertical relay such as 506 and a trunk vertical relay such as 509 for connecting a control circuit to the sender associated with start relay 502. Each control circuit is preferentially common to all the senders in the exchange in accordance with the busy condition of its adjacent trunk vertical relays as will be described hereinafter.

With relay 404 operated the circuit for start relay 502 may be traced from ground on the right front contact of relay 404, conductor 530, right winding of relay 502 through the left back contact of relay 501 to battery. Relay 502 energizes in the foregoing circuit and completes a locking circuit for itself from battery, winding of relay 501, left front contact and left winding of relay 502, conductor 530, to ground on the right front contact of relay 404. Relay 501 energizes in this circuit and at its right front contact completes a circuit for operating sender multi-contact relay 506 and control relay 521. These relays are operated in circuits respectively from battery, through the winding of relay 506, the inner right front contact of relay 502 to ground on the front contact of relay 501 and from battery, back contact of relay 523, the right winding of relay 521, the back contact of relay 522, the outer right front contact of relay 502 to ground on the front contact of relay 501. The operation of relay 501 also opens at its left contact the energizing circuits of all other relays similar to relay 502 in group G_1 of the coin control connector, thereby preventing the operation of more than one sender multi-contact relay in that group at one time. Multi-contact relay 506

operates and connects the leads terminating on its contacts to the conductors of the horizontal link 560.

When relay 521 operates, it completes a locking circuit for itself from battery, winding of relay 523, the inner left front contact and left winding of relay 521 to ground on the front contact of relay 501. Relay 523 operates in this circuit and completes a circuit for operating coin control multi-contact relay 509 in a circuit from battery, through the winding of multi-contact relay 509, outer left front contact of relay 521 to ground on the front contact of relay 523. Coin control multi-contact magnet 509 operates and connects the sender associated with the calling subscriber's line to the link 580 of the coin control circuit 600.

The coin control connector is so arranged that when a sender associated with one coin control connector group is connected to a coin control circuit no other sender associated with that particular group may have access to a coin control circuit until the preliminary coin test for the first sender has been accomplished and relay 501 is deenergized. This is provided for by operating and locking in series relay 501 and the start relay such as 502 of whatever sender of a particular group of senders is connected to a coin control circuit connector, whereby battery potential is disconnected from the energizing circuits of all other start relays in that particular coin connector group.

In a similar manner, the coin control connector is arranged to prevent the operation at one time of more than one coin control multi-contact relay associated with any particular coin control circuit. This is accomplished by operating a non-interfering relay, such as 523, which attracts its left armature and disconnects battery potential from the energizing windings of all relays similar to 521 associated with the coin control circuit connected to link 580.

If while the sender associated with start relay 502 is connected to the coin control circuit 600 start relay 532 should operate and attempt to connect its associate sender with the coin control circuit 600 already connected to the sender associated with sender 400 it would be prevented from so doing by reason of relay 523 having been operated as a result of the operation of relay 521. The sender associated with start relay 532, however, will be connected to the coin control circuit connected to link 590. This is accomplished in the following manner:

When relay 523 operates, an obvious circuit is closed for energizing relay 552. Relay 552 operates and closes a circuit at its front contact for operating control relay 541 from battery, back contact of relay 513, right winding of relay 541, right back contact of

relay 542 right back contact of relay 533, right back contact of relay 551, front contact of relay 552, outer right front contact of relay 532 to ground on the front contact of relay 531. Relay 541 operates and completes a locking circuit for itself from battery, winding of relay 513, inner left back contact of relay 511, inner left front contact and left winding of relay 541 to ground on the front contact of relay 531. Relay 513 operates in this circuit and by attracting its left armature prevents the operation of all other control relays similar to relay 541 associated with the coin control circuit connected to link 590. When relay 541 operates, it completes a circuit for operating multi-contact relay 538 from battery, winding of relay 538, outer left front contact of relay 541 to ground on the front contact of relay 513. Relay 538 in operating connects the coin control circuit connected to link 590 to a sender in the same manner as described when relay 509 was operated.

At any time, any coin control circuit may be removed from the operation by depressing a make busy key individual to each coin control circuit and similar to key 510. For example, if for any reason it should be desired to remove from operation the coin control circuit connected to link 580, it may be done by depressing key 510. An obvious circuit is then completed for operating relays 552 and 522. Relay 552 and relay 522 in operating cause a sender, which otherwise might be connected to the coin control circuit connected to link 580, to be connected to the coin control circuit connected to link 590, in the same manner as when the coin control circuit connected to link 580 is busy as above described.

As soon as the sender is connected to the coin control circuit, a circuit is closed from battery winding of marginal relay 602, winding of slow releasing relay 601, conductor 631, contacts of relay 509, conductor 519 of horizontal link 560 of the coin control connector, contacts of relay 506, conductor 529, resistance 438, right back contact of relay 411, conductor 456, conductor 437 to ground on the middle right front contact of relay 421. Relay 601 operates in this circuit but relay 602 which is marginal fails to operate due to the fact that resistance 438 is in the circuit. Relay 601 in operating closes circuits for relays 603 and 604.

The circuit for energizing relay 603 may be traced from battery, winding of relay 603 right back contact of relay 605, conductor 637 to ground on the front contact of relay 601. Relay 604 is operated in a circuit from battery, left winding of relay 604, left back contact of relay 605, left back contact of relay 606, right back contact of relay 605, conductor 637 to ground on the front contact of

relay 601. Relay 604 operates and at its inner right front contact prepares a locking circuit for itself.

As soon as relay 601 operates, time measuring circuits are established whereupon at the end of a definite interval of time, during which the preliminary coin test will have taken place, relay 605 is operated thereby permitting the sender to complete or to continue to arrest the establishment of the talking connection depending upon whether or not the coin has been deposited in the coin box. The foregoing operation is described in detail as follows:

15 With relay 601 operated, a circuit is completed for energizing pick-up relay 610 from battery, winding of relay 610, contact 640 of interrupter 642, conductor 639, right back contact of relay 605, conductor 637 to ground on the front contact of relay 601. Relay 610
20 operates and locks in a circuit from battery, its right front contact, conductor 639 to ground as previously described. Upon the closure of interrupter contact 641, a circuit
25 is completed for operating relay 611 from battery, winding of relay 611, back contact of relay 612, left front contact of relay 610, interrupter contact 641, conductor 639 to ground on the front contact of relay 601.
30 Relay 611 operates and completes a holding circuit for itself from battery through its winding, winding of relay 612, left front contact of relay 611, conductor 645, conductor 639 to ground on the front contact
35 of relay 601. Relay 612 does not operate in this circuit at this time since the circuit through relay 612 is shunted through contact 641 of interrupter 642. When interrupter contact 641 opens, the shunt around
40 the winding of relay 612 is removed and relay 612 operates and prepares a circuit for energizing relay 613 upon the next closure of interrupter contact 641. When contact 641 again closes, relay 613 operates in a circuit from battery, back contact of relay 614,
45 front contact of relay 612, left front contact of relay 610, interrupter contact 641, conductor 639 to ground on the front contact of relay 601, and completes a holding
50 circuit for itself from battery, through its winding and the winding of relay 614 in series, its left front contact, conductor 645, conductor 639 to ground on the front contact of relay 601. Relay 614 does not operate
55 at this time since it is shunted through the contact 641 of interrupter 642. When interrupter contact 641 again opens the shunt around relay 614 is removed and relay 614 operates, and in so doing prepares a
60 circuit for operating relay 615. Upon the next closure of the interrupter contact 641, a circuit is completed for energizing relay 615 from battery, right back contact of relay 616, front contact of relay 614, front
65 contact of relay 612, left front contact of

relay 610, interrupter contact 641, conductor 639 to ground on the front contact of relay 601. Relay 615 operates and completes a holding circuit for itself from battery, through its winding and the winding of relay 616 in series, its left front contact, outer left back contact of relay 608, outer right back contact of relay 605, conductor 637 to ground on the front contact of relay 601. Relay 616 fails to operate at this time since
70 it is shunted through contact 641 of interrupter 642. When interrupter contact 641 next opens, the shunt around relay 616 is removed, whereupon relay 616 operates and prepares at its front contact a circuit for
80 operating relay 605. Upon the next closure of interrupter contact 641, a circuit is completed from battery, winding of relay 605, front contacts of relays 616, 614 and 612 in series, left front contact of relay 610, interrupter contact 641, conductor 639 outer right
85 back contact of relay 605 to ground on the front contact of relay 601. Relay 605 operates and closes its outer right front contact before it opens its right back contact so that
90 a circuit for locking relay 605 is completed from battery, winding and outer right front contact of relay 605, conductor 637 to ground on the front contact of relay 601 before the initial energizing circuit for operating relay
95 605 is opened at its right back contact. Relay 605 in operating also opens at its left back contact the initial energizing circuit of relay 604.

During and before the expiration of the
100 interval of time measured by the operation of the counting relays and before the operation of relay 605 which has just been described, a test circuit will have been completed and will have made a test of the calling
105 subscriber's line to determine whether the calling subscriber has deposited the proper coin or not.

With relay 603 operated, a circuit is completed for making a preliminary test of the
110 calling subscriber's line for the proper coin from a 110 volt negative battery source, right front contact of relay 603, conductor 651, left back contact of relay 609, conductor 652, through the right winding of marginal
115 relay 617, outer right back contact of relay 607, intermediate winding of relay 618, conductor 653, outer right back contact of relay 629, conductor 654, contact of relay 509, conductor 518 of horizontal link 560, contact of
120 relay 506, conductor 528, outer left front contact of relay 404, right inner back contact of relay 420, right intermediate back contact of relay 403, conductor 441, contacts and horizontal link 375 of sender selector
125 switch 300, conductor 358, conductor 13, contacts and horizontal link of line switch 25, conductor 9, substation 10, conductor 8, contacts and horizontal of line switch 25, conductor 12, conductor 357, contacts and hori-
130

zontal 375 of sender selector switch 300, conductor 442, outer right back contact of relay 403, outer right back contact of relay 420, inner left front contact of relay 404, conductor 527, contact of relay 506, conductor 517 of horizontal link 560, contact of relay 509, conductor 655, inner right back contact of relay 629, conductor 656, left winding of relay 618, inner right back contact of relay 607, left winding of relay 617 to ground through the resistance 625. Relay 618 operates in the foregoing circuit, but marginal relay 617 does not operate because of the presence of resistance 625 in this circuit. However, if there is a coin in the coin-box or a ground improperly on the line, a circuit shunting the resistance 625 will be completed either through the windings of coin collect magnet 15 to ground 16 through the contacts 17 closed by a deposited coin or to ground improperly on the line as the case may be causing marginal relay 617 to operate. Therefore, it is to be observed that if relay 617 does not operate, it indicates that the calling subscriber has failed to deposit a coin in the coin box and that the line is not improperly grounded. Coin magnet 15 is not operated in the above circuits as the current is not of sufficient strength to operate it.

When relay 617 operates, it completes a locking circuit for itself from the source of negative potential through its right winding as described, its inner right front contact, conductor 657 to ground on the front contact of relay 601. With relay 617 operated, a circuit is completed for operating relay 607 from battery, right front contact of relay 617, winding of relay 607 to ground on the front contact of relay 601. Relay 607 operates and at its right front contacts transfers the subscriber's loop from the windings of relay 617, through the left and intermediate windings of relay 619 to test for a direct ground at the coin box. This circuit may be traced from source of negative battery, right front contact of relay 603, conductor 651, left back contact of relay 609, conductor 652, middle winding of relay 619, outer right front contact of relay 607 intermediate winding of relay 619, conductor 653, outer right back contact of relay 629, conductor 654, thence as previously described, conductor 655, inner back contact of relay 629, conductor 656, left winding of relay 618, inner right front contact of relay 607, left winding of relay 619, to ground through the back contact of relay 619 and the contact of relay 601. Relay 619 is designed to operate in a circuit with only a comparatively small resistance and is unable to operate through the resistance of the coin collect magnet windings.

If there is, therefore, a direct ground improperly on the line, relay 619 will operate and provide a locking circuit for relay 604

which may be traced from battery, right winding and right front contact of relay 604, conductor 658, right front contact of relay 619, conductor 657 to ground on the front contact of relay 601. Relay 619 in operating also removes the shunt around its right winding including this winding in series with its left winding. If the coin has been deposited and there is no direct ground on the line, relay 619 will not operate and consequently a holding circuit will not be provided for holding relay 604 operated after its initial energizing circuit through its left winding is opened at the left back contact of relay 605 which operates, as previously described, upon the expiration of the time measured by the counting relays. Relay 604 will thereupon deenergize.

It should be observed at this time that the sender has not succeeded in establishing the connection beyond the release of the district marker because the energizing circuit, through the right back contact of relay 406 and the left front contact of relay 411 for operating the line marker sender connector for attaching a line marker to the sender, as described and illustrated in the aforesaid patent to S. B. Williams, is held open at the left front contact of unoperated relay 411. It is obvious that until relay 411 is operated, the talking connection cannot be extended to the called subscriber's line.

Assuming that the calling subscriber has deposited the proper coin in the coin box, relays 618, 617 and 607 will have operated so that the circuit through the right winding of relay 604 is opened at the left back contact of relay 607. At the expiration of the period of time measured by the counting relays, relay 605 is operated and opens the energizing circuit of relay 604 causing it to deenergize. Relay 605 in operating disconnects ground at its outer right back contact from conductor 639, thereby causing the deenergization of the counting relays 611, 612, 613, 614, 615, 616 and relay 610 and 603.

With relay 604 deenergized a circuit is completed for energizing relay 411 in the sender. This circuit may be traced from battery, winding of relay 411, outer back contact of relay 408, conductor 524, contact of relay 506, conductor 514 of horizontal link 560, contact of relay 509, conductor 659, outer left back contact of relay 621, inner left back contact of relay 604, inner left back contact of relay 608, outer left back contact of relay 616, inner right front contact of relay 605 to ground on front contact of relay 601. Relay 411 operates and in so doing establishes a circuit, as described in the aforesaid patent to S. B. Williams, for initiating the operation of the line marker. This circuit may be traced from ground on the inner left contact of relay 421, outer left back contact of relay 403, front contact of units register

relay 927, back contact of relay 424, front contact of district marker release relay 425, back contacts of relays 418, 409, 410 and 427 in series, left front contact of relay 407, left front contact of relay 411, right back contact of relay 406, conductor 455 to grounded battery in the sender register circuit (not shown).

The operation of the line marker completes the establishment of the connection to the called subscriber's line whereupon ringing current is placed on the called subscriber's line in a manner well known in the art and described in the aforesaid patent to S. B. Williams.

Assuming that the preliminary coin test is satisfactory and that relay 411 is operated as previously described the energizing circuit for relay 404 is opened at the inner left contact of relay 411. Relay 404 releases and at its right front contact opens the energizing circuit of relays 501 and 502. Relay 501 releases and in so doing opens at its right front contact the energizing circuits for relays 506, 521 and 523. Relay 506 releases and disconnects the sender from the horizontal link circuit 560. Relay 523 deenergizes and releases relays 522 and 552. The release of relay 523 also connects battery potential to the energizing circuits of all relays similar to relay 521 dependent on grounded battery through the back contact of relay 523 for battery potential. Relay 521 releases and at its outer left front contact opens the energizing circuit for coin control multi-contact relay 509. Relay 509 deenergizes and disconnects coin control circuit 600 from the horizontal link circuit 500.

It will be noted that all relays in the coin control connector controlled by relay 501 have been released and that coin control connector group G_1 is in condition to again permit the coin connector switch circuit to connect a coin control circuit to the sender which next causes the operation of a start relay in group G_1 , and that coin control circuit 600 is again idle and free to be connected to a sender.

When relay 411 operated it opened at its right back contact the energizing circuit for relay 601. Relay 601 releases and opens the energizing circuits for relays 605, 607 and 617 all of which release. When relay 404 releases it opens at its inner and outer left front contacts the connection between the line loop and the windings of relay 618 causing the latter to deenergize and at its middle left front contact opens the holding circuit of relay 401. It will be observed that all operated relays in the coin control circuit have now been released.

After the line marker has been disconnected from the sender, relay 406 is operated as described in the aforesaid patent to S. B. Williams. Relay 406 in operating completes

a circuit for operating sender release relay 403. This circuit may be traced from battery, left winding of relay 403, conductor 663, left back contact of stations register control relay 1013 in the sender register, right front contact of relay 406, the inner left front contact of relay 411, left front contact of relay 407, back contact of relay 427, back contact of relay 410, back contacts of relays 409 and 418, left front contact of relay 425, back contact of relay 424, front contact of units register control relay 927 in the sender register, innermost right back contact of relay 403 to ground on the inner left front contact of relay 421. Relay 403 operates and completes a locking circuit for itself over its front contact to ground on the middle right front contact of relay 421, and its right hand back contacts open the initial energizing circuit of relay 403 and the circuit including the calling subscriber's line and the impulse relay 401 which releases. It is to be noted that relay 403 in operating closes its front contact before opening its innermost right back contact thereby completing a locking circuit for itself before opening the initial energizing circuit. Relay 403 in operating also opens at its left back contact the holding circuit of relay 421. Upon the release of pulsing relay 401 slow release relay 423 releases and opens the initial energizing circuit of relay 421. Relay 421 is therefore released at this time causing ground potential to be removed from the various holding conductors thereby causing all the relays in the recording sender to deenergize and release.

When relays 423 and 403 release, the holding circuit of horizontal magnet 306 of the sender selector switch 300 is opened at the outer right front contact of relay 423 and the left back contact of relay 403. Horizontal magnet 306 releases and in so doing restores its associated horizontal rod so that the recording sender is disconnected from the district selector circuit 100 and returned to normal. The release of relays 403 and 423 also opens the energizing circuit of relay 101. When relay 101 releases it opens the energizing circuit for slow release relay 112. Slow release relay 112 however remains operated for a short interval of time. During the interval in which relay 112 is releasing a circuit is completed for operating relay 103 from battery, left front contact of relay 112, winding of relay 103, outer right back contact of relay 104, inner right back contact of relay 101 to ground on the left front contact of relay 102. Relay 103 operates and completes a locking circuit for itself from battery, inner left front contact of relay 103 to ground over the circuit just described. When relay 112 releases it opens the energizing circuit of relay 102. However, since relay 102 is also a slow release relay it holds

its armatures attracted for a short interval of time. During the interval of time within which relays 112 and 102 are releasing, relay 103 is held operated in a circuit to ground on the left front contact of relay 102. With relay 103 operated, a circuit is completed for operating supervisory relay 113 from battery, lower right winding of repeating coil 160, winding of relay 113 inner left back contact of relay 101, conductor 13 over the ring side of the line to the calling subscriber's station 10, back over the tip side of the line, conductor 12, outer left back contact of relay 101, inner left back contact of relay 104, outer right front contact of relay 103 to ground through the lower left winding of repeating coil 160. Relay 113 operates and completes an obvious circuit for holding relay 112 energized. Relays 112 and 102 are made slow releasing so as to allow sufficient time for relay 113 to operate and reenergize relay 112 which in turn reenergizes relay 102 before it releases since it is obvious that if relay 102 should release its armature, ground on its front contact for holding the line switch, the district selector switch and the subsequent train of switches would be disconnected, the foregoing switches released and connection disestablished.

Relays 112 and 102 are now held under the control of relay 113 and the calling subscriber's switchhook. Relay 102 maintains ground potential on sleeve conductor 11 to hold operated the line switch, district selector switch, and the subsequent train of switches, as disclosed in the aforesaid patent to S. B. Williams.

Relay 103 in operating also provides supervision over the called subscriber's line. Assuming that the call was routed for example to a call indicator of local mechanical office, relay 105 or relay 106 is operated accordingly. If the called subscriber is situated in a call indicator office, relay 105 is operated in a circuit from battery, through its winding, lead 1147 to a ground in a district marker (not shown) as described in the aforesaid patent to S. B. Williams. Relay 105 in operating prepares at its inner left front contact and outer left front contact the circuit for including polarized relay 107 in a circuit over the called subscriber's line. When the called subscriber in the call indicator office answers, current flowing through relay 107 is reversed, thereby operating polarized relay 107. If relay 107 remains steadily operated, a circuit is completed for operating relay 109 under the control of interrupter contact 133. This circuit may be traced from battery, on the outer left front contact of relay 103, right front contact of relay 107, right back contact of relay 108, winding of relay 109, right back contact of relay 109, interrupter contact 133 to ground. Relay 109 operates

and at its inner right hand armature completes a locking circuit for itself before this armature opens the initial energizing circuit. When interrupter contact 131 next closes a circuit is completed for energizing charging relay 108 from battery winding of relay 108, outer right front contact of relay 109 to ground through the closed interrupter contact 131. Relay 108 operates and completes a locking circuit for itself from battery, through its winding and inner left front contact, inner right front contact of relay 103 to ground on the front contact of relay 102. Relay 108 in operating opens the energizing circuit of relay 109, thereby releasing relay 109. The operation of relay 108 prepares a circuit to be hereinafter described for collecting the coin at the end of the conversation.

If the called subscriber is situated in the local mechanical office, when the called subscriber, for example the subscriber at station 700, answers a circuit is completed from battery through the winding of relay 106, left back contact of relay 105, upper left winding of repeating coil 160, ring side of trunk 130 returning over tip side of trunk 130, middle right front contact of relay 103, upper right winding of repeating coil 160 to ground on the outer left back contact of relay 105. Relay 106 operates in this circuit and completes a circuit similar to that described above for operating relay 109 except that the path is through the front contact of relay 106 instead of the front contact of polarized relay 107. Relay 108 in the same manner, as described above, operates to prepare a circuit for collecting the coin at the end of the conversation and releases relay 109.

After the conversation is terminated and the calling subscriber has replaced his receiver on the switchhook, the circuit for energizing supervisory relay 113 is opened at the calling subscriber's station, releasing relay 113. Relay 113 in releasing opens the energizing circuit of relay 112. Relay 112 releases and opens the circuit for slow release relay 102 which, remains operated for a short interval of time thereafter. Before relay 102 releases, a circuit is completed from battery, inner left front contact of relay 103, left winding of relay 110 to ground on the right back contact of relay 112. Relay 110 operates and immediately completes a circuit for operating relays 311 and 201. This circuit may be traced from battery, winding of relay 311, conductor 221, winding of relay 201, conductor 123, outer left front contact of relay 110, conductor 141, inner right back contact of relay 101 to ground on the left front contact of relay 102. Relay 201 operates and closes a circuit for reenergizing relay 102 before it can release. This circuit may be traced from

battery, winding of relay 102, conductor 125 to ground on the outer left front contact of relay 201. Relay 201 in operating completes a holding circuit for itself and relay 311 over its inner left front contact, conductor 124, inner right back contact of relay 101 to ground on the front contact of relay 102.

The operation of relay 311 at this time completes a circuit for selecting a special sender arranged not to register pulses but to collect or return the coin. Relay 311 in operating causes sender vertical magnet 325 to operate in the same manner as previously described for the selection of a recording sender. When the horizontal group relay 210 and the vertical group relay 314 operate, circuits are completed for operating relays 223 and 207 respectively. The circuit for operating relay 223 may be traced from battery, winding of relay 223, conductor 236, outer left front contact of relay 314, conductor 228, front contact of relay 225 to ground on the inner back contact of relay 224, and the circuit for operating relay 207 may be traced from battery, winding of relay 207 to ground on the outer left front contact of relay 210. Relays 223 and 207 are quick acting relays and will complete a circuit for energizing relay 315 before the sender vertical magnet 325 operates and closes its front contacts. This circuit may be traced from battery, winding of relay 315, conductor 323, link conductor 237, uppermost closed contact of relay 223, conductor 238, innermost right front contact of relay 207, middle right front contact of relay 201, conductor 132 to ground on the inner left front contact of relay 110. Relay 315 in operating completes a circuit for energizing trunk vertical magnet 331. It is to be noted that relay 315 determines the selection of either a recording sender or a coin control connecting circuit dependent upon whether relay 315 is in an unoperated or operated condition, respectively.

Trunk vertical magnet 331 in operating prepares the contacts controlled by the vertical rod associated with magnet 331 for connection with the conductors of horizontal link 375. Trunk vertical magnet 331 in operating also completes at its lower middle front contact a circuit for operating horizontal magnet 306. This circuit may be traced from battery, right winding of horizontal magnet 306, left back contact of horizontal relay 217, right front contact of horizontal group relay 210, back contacts of other horizontal group relays 211 and 212 in series, conductor 235, lower front contact of sender vertical magnet 325 to ground on the lower middle front contact of vertical magnet 331. Horizontal magnet 306 operates and connects the district selector circuit 100 to the special coin sender 450.

With district selector circuit 100 connected to special coin sender 450 a circuit is com-

pleted for operating holding relay 451 from battery, winding of relay 451, conductor 452 to ground on the lowest front contact of trunk vertical magnet 331. Relay 451 operates and completes a locking circuit for itself from battery through its winding and inner right front contact to ground on the back contact of release relay 435. After horizontal magnet 306 operates, vertical magnets 325 and 331 release as previously described. Relay 451 in operating connects ground on the back contact of release relay 435 to conductor 452 through the inner right front contact of relay 451 for holding horizontal magnet 306 and relay 217 operated after the release of vertical magnet 331. The vertical group and horizontal group relays and their associated relays are deenergized in the same manner as when a recording sender is connected to the line. When trunk vertical magnet 331 operated, a circuit was also completed for operating relay 101 from battery, winding of relay 101, conductor 359, contact of sender vertical magnet 325, conductor of horizontal link 375, contact of trunk vertical magnet 331, conductor 316 to ground on the lowermost front contact of trunk vertical magnet 331. Relay 101 is held operated after the release of magnet 331 in a circuit over conductor 452, right front contact of relay 451 to ground at release relay 435. Upon the operation of trunk vertical magnet 331, a circuit for holding relay 110 operated was also completed from battery, right winding and inner right front contact of relay 110, conductor 359 to ground on the lowermost front contact of magnet 331, and after the release of magnet 331, the holding circuit for relay 110 is completed over conductor 452, inner right front contact of relay 451 to holding ground on the back contact of relay 435.

Relay 111 is now energized in a circuit from battery, left winding of relay 111, inner right front contact of relay 110, conductor 359 to ground, as previously described. Relay 111 operates and completes a locking circuit for itself from battery, right winding and right front contact of relay 111, conductor 359 to ground, as previously described. Relay 111 in operating provides an additional holding circuit for relay 108 traceable from battery, winding and inner left front contact of relay 108, inner left front contact of relay 111 to ground on the left front contact of relay 102.

When relay 101 operates it opens at its inner back contact the energizing circuits of relays 201 and 311 which release. Relay 201 in releasing opens the energizing circuit of relay 102 at its outer left front contact. Since relay 102 is a slow releasing relay, the operation of relay 101 will complete a new energizing circuit for relay 102 from battery, winding of relay 102, outer left front

contact of relay 111, right front contact of relay 101 to ground on the front contact of relay 102 before relay 102 can release. Relay 101 in operating opens at its inner right back contact the energizing circuit of relay 103 which deenergizes. Relay 103 in deenergizing opens at its inner left front contact the initial energizing circuit for relay 110. Relay 110 does not deenergize since it is held operated over its right winding and right front contact as previously described. The release of relay 103 opens the holding circuit of relay 108. Relay 108 does not deenergize at this time since it is held operated in a circuit through its inner left front contact and the inner left front contact of relay 111.

When relay 451 operates, it completes a circuit for energizing a start relay in a coin control connector associated with the selected special coin sender 450. This circuit may be traced from battery, back contact of non-interfering relay 501, right winding of start relay 503, conductor 520 to ground on the outer right front contact of relay 451. Relay 503 operates and causes the coin control connector to operate and attach an idle coin control circuit to the special coin sender 450 in the same manner as previously described for connecting a coin control circuit to a recording sender for preliminary coin test.

The start relays, such as relay 503, associated with the special coin senders, since they are independent of the start relays associated with the recording senders, may be included in a start relay group including start relays individual to recording senders, as shown in this case, or they may be arranged in a separate start relay group with access to a sufficient number of coin control circuits.

When the coin control circuit is attached to the special sender 450, a circuit is completed for operating relay 606. This circuit may be traced from battery, winding of relay 606, conductor 622, contacts of relays 507 and 509 and lead 516 of horizontal link 560, conductor 546, to ground on the outer right front contact of relay 451. A circuit is also completed from battery, winding of marginal relay 602, winding of relay 601, conductor 631, contact of multi-contact relay 509, lead 519 of horizontal link 560, contact of multi-contact relay, conductor 549, contacts and lead of horizontal link 375, conductor 353, outer right front contact of relay 110, inner left front contact of relay 108, inner left front contact of relay 111 to ground on the left front contact of relay 102. Relays 601 and 602 operate in this circuit. The marginal relay 602 operates in this circuit since the circuit does not include the resistance 436.

With relays 601 and 606 operated, a circuit is completed for operating relays 629

and 609 from battery, windings of relays 629 and 609 in series, inner back contact of relay 616, outer right back contact of relay 604, left front contact of relay 606, outer right back contact of relay 605, conductor 637, to ground on the front contact of relay 601. Relay 609 operates and completes at its outer left front contact a holding circuit for relays 609 and 629. With relays 629 and 609 operated a circuit is completed for operating relay 608 from battery, left front contact of relay 629 to ground on the outer left front contact of relay 609. Relay 608 operates and completes an obvious locking circuit for itself. Relay 601 in operating also completes a circuit for operating relay 603 from battery through the winding of relay 603, outer right back contact of relay 605 to ground on the front contact of relay 601.

When relay 601 is operated a circuit is prepared for starting the operation of the time counting relays. Upon the closure of interrupter contact 640 a circuit is completed for energizing relay 610. This circuit may be traced from battery, winding of relay 610, back contact of relay 610, interrupter contact 640, outer back contact of relay 605 to ground on the front contact of relay 601. Relay 610 operates and completes a locking circuit for itself from battery, through its winding and right front contact to ground as previously described. Upon the subsequent closure of contact 641, a circuit is completed from battery, winding of relay 611, back contact of relay 612, left front contact of relay 610, interrupter contact 641 to ground, as previously described. Relay 611 operates and at its left front contact prepares a circuit for operating relay 612 and for holding itself energized upon the opening of interrupter contact 641 in the same manner as hereinbefore described.

With relay 611 operated 110 volts positive battery potential is connected to the tip and ring sides of the calling subscriber's line. 110 volts positive battery potential is connected over the tip side of the line from 110 volts positive battery source, left front contact of relay 603, outer right contact of relay 602, inner right front contact of relay 611 inner right back contact of relay 613, inner right back contact of relay 615, inner right front contact of relay 629, conductor 655, contact of vertical relay 509, lead 517 of horizontal link 560, contact of vertical relay 507, conductor 547, contacts and horizontal link 375 of switch 300 conductor 357, to conductor 12 on the tip side of the calling subscriber's line, windings of polarized coin collect magnet 15, contacts 17 to ground 16. Current is in such a direction through the magnet 16 as to cause it to operate to collect the deposited coin in a manner well known

in the art. 110 volts positive battery potential is connected over the ring side of the line from 110 volts positive battery source, left front contact of relay 603, outer right front contact of relay 602, outer right front contact of relay 611, outer right back contact of relay 613, outer right back contact of relay 615, outer right front contact of relay 629, conductor 654, contact of relay 509, conductor 518 of horizontal link 560 of the coin control connector, contact of relay 507, conductor 548, contacts and lead of horizontal link 375 of sender selector switch 300, conductor 358, conductor 13, contacts and lead of horizontal link 25, to conductor 9. Since the circuit over the subscriber's line is open at the subscriber's station as a result of the subscriber having hung up his receiver, 110 volts positive battery potential over the ring side operates no apparatus but prevents a "click" in the subscriber's ear if he should remove the receiver from the hook at this time.

When interrupter contact 641 next opens, relay 612 operates and prepares a circuit for energizing relay 613 as previously described. Upon the next closure of interrupter contact 641, relay 613 operates in a circuit from battery, back contact of relay 614, front contact of relay 612, left front contact of relay 610, closed interrupter contact 641, conductor 639 to ground as previously described. Relay 613 in operating disconnects 110 volts positive battery potential from the tip and ring sides of the line at its back contacts and connects the tip and ring sides of the line to ground through the condenser 623 for the purpose of discharging the subscriber's line of the charge of collection current which was applied for collecting the deposited coin.

Upon the next opening of interrupter contact 641, relay 614 is energized and prepares a circuit for operating relay 615. Upon the next closure of interrupter contact 641, relay 615 operates and at its back contacts removes ground potential through condenser 623 from the tip and ring sides of the line.

Relay 615 in operating connects the left and right windings of differential relay 624 to the tip and ring sides respectively of the subscriber's line over the circuits previously traced. If the tip side of the line is grounded through the windings of coin magnet 15 and contacts 17 due to a stuck coin, relay 624 is operated in a circuit through its left winding, inner right front contact of relay 615, inner right contact of relay 629 over the tip side of the line through the windings of coin magnet 15 and contacts 17 to ground 16. Relay 624 operates and completes a circuit for operating relay 626 from battery, winding of relay 626, front contact of relay 624, conductor 645, conductor 639,

to ground on the left front contact of relay 609. The coin control connector circuit is held operated as a result of the operation of relay 626 and a signal lamp is lighted to indicate that a coin is stuck in the coin box 70 and the coin sender held, as will be explained hereinafter. Upon the next opening of interrupter contact 641 relay 615 is half energized and relay 616 is operated in a circuit from battery, windings of relays 615 and 616 in series, left front contact of relay 615, outer left front contact of relay 608 to ground on the front contact of relay 601.

If the coin is collected and there is no improper ground on the line at this time, relay 624 will remain deenergized. When interrupter contact 641 again opens, relay 616 is energized as described in the foregoing paragraph. Relay 616 in operating opens at its inner left back contact the energizing circuit for relays 629 and 609 which thereupon deenergize. The deenergization of relays 629 and 609 prepares a circuit for operating the release relay 435 in the special coin circuit. Upon the next closure of interrupter contact of relay 641, a circuit is completed from battery, winding of relay 605, right front contacts of relays 616, 614 and 612 in series, left front contact of relay 610, interrupter contact 641, conductor 639, outer right back contact of relay 605, conductor 637 to ground on the front contact of relay 601. Relay 605 operates and completes a locking circuit for itself as previously described. Relay 605 in operating opens the holding circuit of relays 611, 612, 613, 614, and relay 610 at its outer right back contact causing these relays to deenergize. Relays 615 and 616 are held operated over the left front contact of relay 608 as previously described.

With relay 609 released, a circuit is completed for operating the sender release relay 435 in the special coin sender 450. This circuit may be traced from battery, winding of relay 435, conductor 544, contact of relay 507, lead 514 of horizontal link 560 contact of relay 509 conductor 659, outer left back contact of relay 621, inner left back contact of relay 604, inner left front contact of relay 608 to ground on the left back contact of relay 629. Release relay 435 operates and opens the holding circuits of relays 451 and 217 and horizontal magnet 306, causing the relays and magnet to release. The operation of release relay 435 also opens at its back contact the energizing circuits of relays 101, 111 and 110, all of which release. If no coin were to be collected on the call, relay 110 would not have operated and connected ground to its outer right front contact so that the circuit for preventing relay 601 would include resistance 436, therefore, the release of relay 451 would disconnect at its left front contact the energizing circuit

through relay 601 causing it to deenergize. But since a coin was collected on this call, relay 110 was operated and its release now opens at its outer right front contact the energizing circuit for relays 601 and 602 in the coin control circuit causing them to release.

Relay 451 in releasing opens the circuit of start relay 503 and relay 501 at its outer right front contact. Start relay 503 releases and causes the release of the coin control connector circuit, as previously described. The release of the coin control connector circuit thereupon disconnects the coin control circuit from the special coin sender.

With relay 601 released, holding ground is disconnected from its front contact causing all relays in the coin control circuit not yet deenergized to deenergize and release, thereby returning the coin control circuit to normal.

Horizontal magnet 306 in releasing restores its associated horizontal rod 370 to normal, thereby disconnecting the coin sender 450 from the district selector circuit 100. It will be observed that the sender selector 300, the special coil sender 450, the coin control connector 500 and the coin control circuit 600 have returned to normal.

Relay 101 in releasing opens at its outer right front contact the energizing circuit for holding relay 102 operated. Relay 111 in releasing opens the energizing circuit of charging relay 108 causing this relay to release if it is energized. Relay 110 in releasing its outer left contact prevents relays 201 and 311 from energizing by opening the energizing circuit of these relays while slow release relay 102 is releasing its left front armature. Relay 102 in releasing removes ground from the conductor 11, thereby deenergizing the line switch horizontal magnet (not shown) and restoring the line switch to normal. Relay 102 in deenergizing also removes ground from the district selector switch holding conductor 142, thereby returning the district selector switch (not shown) and all subsequent selector switches to normal in the manner described in the patent to S. B. Williams, hereinbefore referred to.

If the call should be one for which no charge is made, such as a call to an official of the telephone company, neither relay 106 nor polarized relay 107 will be operated upon the completion of the call and consequently relay 108 will not be operated. However, since it is necessary for the subscriber to deposit a coin in order to operate relay 411 to advance the establishment of the connection, means are provided for returning the coin after the termination of the talking connection.

When the calling subscriber hangs up

upon the termination of a free line call, supervisory relay 113 releases and in so doing opens the energizing circuit of slow-release relay 112. Relay 112 in releasing, opens the energizing circuit of relay 102, which slowly releases. Before relay 112 can fully release, a circuit is completed from battery, inner left front contact, of relay 103, left winding of relay 110, to ground on the right back contact of relay 112. Relay 110 operates and completes a circuit for operating relays 201 and 311. This circuit may be traced from battery, windings of relays 311 and 201 in series, conductor 123, left front contact of relay 110, inner left back contact of relay 101, to ground on the front contact of relay 102.

Relay 311 in operating, causes a sender selector to operate and connect a special coin sender to the coin district selector circuit, whereupon the coin control connector is operated and connects an idle coin control circuit in the same manner as previously described for the collection of a coin.

With the coin control circuit connected to the special coin sender, a circuit is completed from battery, windings of relay 602 and 601 in series, conductor 631, contact of relay 509, conductor 519 of horizontal link 560 of the coin control connector, contact of relay 507, conductor 549, to ground on the front contact of relay 451 through resistance 436. Marginal relay 602 does not operate in this circuit, since it is in series with the resistance 436 and the shunt to direct ground is not completed, since charge relay 108 in the district selector circuit is not operated as a result of the failure of relay 106 or 107 to operate.

The counting relays in the coin control circuit thereupon begin to count off time, as previously described. When relay 611 operates, 110-V. negative battery potential is connected to the tip and ring sides of the calling subscriber's line. 110-V. negative battery potential is connected to the tip side of the line in a circuit which may be traced from 110-V. negative battery source, right front contact of relay 603, outer back contact of relay 602, inner right front contact of relay 611, inner right back contacts of relays 613 and 615 in series, to the tip side of the calling subscriber's line as previously traced, windings of coin collect polarized magnet 15, contact 17, to ground 16. Coin collect magnet 15 operates and returns the coin in the well known manner. Negative battery connected to the ring side has no function other than to prevent a "click" in the calling subscriber's ear if he should lift the receiver from the hook at this time.

The counting relays thereupon continue their operation and, when relay 613 operates, battery potential on the line is discharged through condenser 623, and when

relay 615 operates a test is made for a stuck coin, and afterwards relay 451 in the special coin sender is deenergized, all operations being accomplished in the same manner as when a coin in a coin box was to be collected. The release of relay 451 opens at its left front contact the energizing circuit through relay 601, causing it to deenergize and to return the coin control circuit to normal. The release of relay 451 in addition causes the disestablishment of the connection and the return to normal of all circuits used therein, in the same manner as described in collecting a coin.

If the called subscriber fails to answer the ringing signal, neither relay 106 nor polarized relay 107 operates. Whereupon when the calling subscriber disconnects, the coin is returned in substantially the same manner as when a call is returned on a free line call.

When relay 626 is operated as a result of a stuck coin on collection, a circuit for holding relays 629 and 609 operated is completed from battery, windings of relays 629 and 609 in series, right front contact of relay 609, to ground on the inner left front contact of relay 626. Relay 616 operates as previously described at the end of the period of time measured by the counting relays and opens the initial energizing circuit of relays 629 and 609. However, relays 629 and 609 remain energized over the holding circuit. The failure of relay 629 to release its outer left armature, holds open the energizing circuit of release relay 435 in the special coin sender. The failure of relay 435 to operate causes relay 451 to remain operated. While relay 451 remains operated, the coin control circuit, the coin connector circuit, the special coin sender, the sender selector, the line switch circuit, and the district selector and its subsequent train of switches, are held operated. Since the coin is stuck on collection, marginal relay 602 is operated as previously described and a circuit is completed from battery, windings of relays 432 and 433 in series, conductor 545, contact of relay 507, conductor 515 of horizontal link 560, contact of relay 509, conductor 662, left front contact of relay 626, inner right front contact of relay 602, on the left front contact of relay 609, to ground. Relays 432 and 433 operate in this circuit. With marginal relay 433 and relay 432 both operated, a circuit is completed from battery, through stuck coin signal lamp 664 back contact of relay 665, front contact of relay 432, front contact of relay 433, to ground. Lamp 664 burns steadily and informs a monitoring operator that a coin is stuck on coin collection.

When the coin is stuck on coin return after a free line call or after a call which is not answered by the called party, the operation of the stuck coin signal is the same except that since marginal relay 602 is not oper-

ated, the circuit through the windings of relays 432 and 433 in series is therefore completed through the inner right back contact of marginal relay 602, resistance 663 to ground. Relay 432 operates but marginal relay 433 does not operate, because of the inclusion of resistance 663 in the circuit. With relay 432 operated and relay 433 unoperated, a circuit is completed from battery through the signal lamp 664, back contact of relay 665, front contact of relay 432 and back contact of relay 433 to interrupted ground, causing the lamp 664 to flash and signal the operator that a coin is stuck on coin return.

If the calling subscriber should abandon the connection before preliminary coin test is begun, or more specifically before the operation of relay 404, pulsing relay 401 will release, since its energizing circuit is open at the calling subscriber's station. Relay 401 in releasing, causes relay 423 to release. Relay 423 in releasing, opens the initial energizing circuit of relay 421 which remains operated, however, over its holding circuit which may be traced from battery, through its winding and inner right front contact, left back contact of relay 403, to ground on the inner left front contact of relay 421. With relay 423 released, a circuit is completed for operating relay 408 from battery, winding of relay 408, outer right front contact of relay 421, to ground on the back contact of relay 423.

Relay 423 in deenergizing, also completes a circuit for energizing relay 417, which may be traced from battery, winding of relay 417, outer left back contact of relay 411, outer right front contact of relay 421, to ground on the inner right back contact of relay 423. Relay 417 operates and at its inner left front contact completes a locking circuit for itself, and relay 408. Relay 417 in operating, also completes a circuit from battery, winding of relay 404, to ground on the inner right front contact of relay 417. Relay 404 operates in this circuit and causes the coin control connector to connect a coin control circuit to the sender as previously described. Relay 404 in operating, also connects at its inner left front contact and its outer left front contact the calling subscriber's line with the coin control circuit. Relay 404 in operating completes a circuit for operating relay 401 from battery right winding of relay 401, middle left front contact of relay 404, to ground in the middle right front contact of relay 421. Relay 401 in operating operates relay 423 which restores the control energizing circuit for relay 421, and opens the initial energizing circuits of relays 408 and 417.

With coin control circuit 600 attached to the recording sender, the coin control circuit operates to refund the coin as follows: Relay 601 is operated in a circuit from bat-

tery, winding of marginal relay 602, winding of relay 601, conductor 631, contact of relay 509, conductor 519 of horizontal link 560, contact of relay 506, conductor 529, resistance 438, back contact of relay 411, to ground on the middle right front contact of relay 421. Relay 601 operates in this circuit, but marginal relay 602 does not operate since the resistance 438 is in series with the winding of the latter relay. With relay 408 operated a circuit is completed from battery, winding of relay 606, conductor 622, contact of relay 509, conductor 516 of horizontal link 560 contact of relay 506, conductor 526, to ground on the inner right front contact of relay 408. Relay 606 operates in this circuit and at its left back contact opens the circuit for energizing relay 604 and completes a circuit for operating relays 629 and 609 as previously described. Relay 629 in operating, completes a circuit for operating relay 608, which locks on the front contact of relay 601 as previously described.

The counting relays then begin to count off time as previously described, and when relay 611 operates 110 V. negative battery potential is connected to the tip and ring sides of the calling subscriber's line. 110 V. negative battery potential over the tip side operates polarized magnet 15, causing it to return the coin to the calling subscriber if a coin has been deposited. When relay 613 operates, negative battery potential on both sides of the line is discharged through condenser 623. When relay 615 operates, a test for a stuck coin is made as hereinbefore explained.

If the coin is not stuck when relay 616 operates, it opens at its inner left back contact the energizing circuit for relays 629 and 609, which deenergize. Relay 629 in deenergizing, completes a circuit from battery, winding of relay 413, right front contact of relay 408, conductor 524, conductor 514 of horizontal link 560, conductor 659, left back contact of relay 621, inner left back contact of relay 604, inner left front contact of relay 608, to ground on the left back contact of relay 629. Relay 413 operates and at its front contact completes a circuit for energizing sender release relay 403 from battery, left winding of relay 403, conductor 663, back contact of relay 419, to ground on the front contact of relay 413. Release relay 403 operates and at its left back contact and innermost right back contact opens the holding circuit of relays 421, 417 and 408 causing these relays to release. Relay 417 in releasing opens the energizing circuit of relay 404 causing it to deenergize. With relay 404 deenergized the circuit for operating relay 401 is opened causing it to release and to in turn release relay 423. Relay 408 in releasing causes the release of relay 413, which in

turn opens the energizing circuit of release relay 403 causing relay 403 to release. Relay 421 in releasing removes ground potential from all relays not yet released in the recording sender thereby causing the sender to be returned to normal as described in the aforesaid patent to S. B. Williams.

Relay 616 in operating, also completes an energizing circuit for relay 605, which locks up on the front contact of relay 601 as previously described. Relay 605 in operating, removes holding ground from the counting relays 610, 611, 612, 613, 614, causing these relays to deenergize. Counting relays 615 and 616 are held energized in a circuit over the outer left front contact of relay 608 and the front contact of relay 601. The release of relays 629 and 609 opens the energizing circuit of relay 603 causing it to release. When relay 421 releases, it opens at its middle right front contact the energizing circuit of holding relay 601 in the coin control circuit, which deenergizes and removes holding ground at its front contact, causing relays 608, 615 and 616 to release. Relay 408 in releasing causes the deenergization of relay 606 in the coin control circuit. With the release of relay 606, it will be observed that all relays in the coin control circuit have now returned to normal.

When relay 404 releases it removes ground at its right front contact from the energizing circuit of relays 501 and 502, causing these relays to deenergize and in turn to release the coin control connector in the same manner as previously described. The release of holding relay 421 causes the deenergization and release of all relays in the sender in the same manner as described in the aforesaid patent to S. B. Williams.

Relay 421 in releasing, removes ground from the energizing circuit of horizontal magnet 306, causing it to deenergize and restore its associated horizontal rod 370 to normal, thereby disconnecting the coin control circuit from the district selector and releasing relay 217. It will be observed that all relays associated with the sender selector have now been returned to normal.

Upon the release of holding relay 421, the circuit for energizing relay 101 is opened at the inner left front contact of relay 421, causing relay 101 to deenergize. Relay 101 in deenergizing, opens at its outer right front contact the energizing circuit of relay 112, causing relay 112 to release. Relay 112 in releasing, opens at its front contact the energizing circuit of relay 102, which causes relay 102 to release. Relay 102 in releasing, disconnects at its left front contact holding ground for maintaining operated the line switch and the district selector switch and, its subsequent train of switches (not shown), causing these switches to be released and return to normal in a manner well known in

the art and described in the aforesaid patent to S. B. Williams.

610, 611, 612, 613, 614, 615 and 616 causing them to release.

If the calling subscriber should abandon the call during preliminary test or more specifically during the time in which relay 404 is operated all relays in the sender are held operated and no operation for effecting a release occurs in the coin control circuit until the preliminary coin test has been finished. Since the call was abandoned after relay 404 was operated relay 401 will remain operated in a circuit over the middle left front contact of relay 404 thereby preventing relay 423 from releasing and causing the operation of relay 408. The failure of relay 408 to operate consequently holds open at its outer right front contact the energizing circuit of relay 413, thereby preventing the completion of an operating circuit for operating release relay 403 and the consequent release of the sender at this time. Relay 601 is held operated in a circuit to ground over a front contact of relay 421 and consequently the counting relays continue to count off time. The abandonment of the call by the subscriber opens the circuit of relay 618 causing it to deenergize immediately. If a coin is deposited, relay 617 is held operated in a circuit through its inner right front contact to ground on the front contact of relay 601. Relay 607 is held operated in a circuit from battery, outer right front contact of relay 617, winding of relay 607 to ground on the front contact of relay 601. If no coin is deposited and there is an unstandard ground on the line relay 619 is held operated in addition to relays 607 and 617. Negative battery connected to the ring side of the line at this time has no effect upon the coin collect magnet 15 since the circuit for energizing the coin collect magnet is opened at the subscriber's station.

When relay 616 operates at the end of the preliminary coin test, a circuit is completed for operating relay 605, as previously described. Relay 605 operates and at its outer right front contact completes a locking circuit for itself. Relay 605 in operating completes a circuit for operating relay 621 from battery, outer right back contact of relay 608, right back contact of relay 618, winding of relay 621, inner right front contact of relay 605 to ground on the front contact of relay 601. At the same time, relay 605 in operating opens the energizing circuit of relay 604 causing it to deenergize. Relay 621 in operating completes a locking circuit for itself from battery, through its inner left front contact and winding to ground over the inner right front contact of relay 605 as previously described. Relay 605 in operating disconnects ground at its outer right back contact from the energizing circuit of relay 603 and the counting relays

With relay 621 operated and relay 604 released a circuit is completed from battery, windings of relays 629 and 609 in series, inner left back contact of relay 616, outer right back contact of relay 604, to ground on the outermost right front contact of relay 621. Relays 629 and 609 operate in this circuit. Relay 609 in operating completes a circuit for again operating relay 603 from battery, winding of relay 603 to ground on the left front contact of relay 609. With relays 609 and 629 operated, a circuit is completed from battery, winding of relay 608, inner left front contact of relay 629 to ground on the left front contact of relay 609. Relay 608 operates and completes a locking circuit for itself over its right front contact to ground on the front contact of relay 601.

With relay 609 operated, the counting relays again start their time measuring operation in a circuit to ground on the left front contact of relay 609. When relay 611 again operates, a circuit is completed for connecting 110 volt negative battery potential to both sides of the line as previously described. If a coin has been deposited, coin magnet 15 is operated by negative battery potential over the tip side of the line and causes the coin to be returned in the same manner as when the call had been abandoned before preliminary coin test. When relay 613 again operates, battery potential is discharged from the line through the condenser 623 and when relay 615 again operates a stuck coin test is made and relay 616 operates as previously described.

Relay 616 in operating, opens at its inner left back contact the energizing circuit for relays 629 and 609, causing these relays to release. Relay 609 in releasing, removes ground from the energizing circuits of relays 603, 610, 611, 612, 613 and 614, causing these relays to release. Relays 615 and 616 remain operated in a circuit over the left front contact of relay 615, outer left front contact of relay 608, to ground on the front contact of relay 601. Relay 629 in releasing, completes a circuit for operating release relay 403 in the recording sender in a circuit from battery, right winding of relay 403, inner right back contact of relay 408, conductor 526, conductor 516 of horizontal link 560, conductor 622, right back contact of relay 626, inner right front contact of relay 621, middle right front contact of relay 608, outer left back contact of relay 604, inner left front contact of relay 608 to ground on the outer left back contact of relay 629. Relay 403 operates and completes a locking circuit for itself from battery through its right winding and right front contact to ground on the middle right front contact of relay 421.

When relay 403 operates, it opens at its innermost right back contact the energizing circuit of relay 404, causing this relay to release and open at its middle left front contact the holding circuit of relay 401, in turn causing its release. Relay 401 in releasing, releases relay 423 which in turn opens the energizing circuit of sender holding relay 421. Relay 421 releases since its holding circuit was opened by the operation of relay 403. Relay 421 in releasing, opens at its middle right front contact the holding circuit of relay 403 and the energizing circuit of relay 601 in the coin control circuit, thereupon causing relays 601 and 403 to release. Relay 601 in releasing, removes ground from the energizing circuits of relays 607, 608, 617, 621, 606, 605, 603, 616 and 615, causing these relays to release. Relay 403 in releasing completes the restoration of the sender. It will be observed that now all relays in the coin control circuit have been released and that consequently the coin control circuit has returned to normal and is available for use with another sender.

Relay 404 in releasing, opens at its right front contact the energizing circuit of start relay 502 and relay 501 in a coin control connector, causing these relays to deenergize and return the coin control connector to normal as previously described.

The release of relay 421 as previously described releases and returns to normal all other switches and apparatus used in establishing the connection up until the time the connection was abandoned.

If the calling subscriber should abandon the call after a preliminary coin test wherein it was found that a coin had been deposited in the coin box, the coin will be returned and the switches operated in establishing the connection returned to normal as follows.

As a result of a satisfactory preliminary test for a coin, relay 411 is operated and locked causing relay 404 to be released.

Relay 401 released since its energizing circuit is opened at the subscriber's station and at the front contacts of relay 404. Relay 401 in releasing opens the energizing circuit of relay 423. Relay 423 in releasing opens the initial energizing circuit of relay 421. Since a coin was deposited in the coin box, relay 411 was caused to operate and complete a circuit for operating the line marker as previously described in the description of the establishment of a connection to a called party. Upon the operation of the line marker, relay 406 is operated, as described in the patent to S. B. Williams, No. 1,517,331, and a circuit is completed from battery, left winding of relay 403, conductor 663 back contact of relay 1013, right front contact of relay 406, inner left front contact of relay 411, left front contact of relay 407, back

contact of relay 427, back contacts of relays 410, 409 and 418, front contact of relay 425, back contact of relay 424, front contact of units register relay 927 in the sender register (not shown), innermost right back contact of relay 403 to ground at the inner left front contact of relay 421. Relay 403 operates sufficiently long enough to open the holding circuit of relay 421 causing it to deenergize. The release of relay 421 causes the recording sender, the coin connector and the coin control circuit to release and return to normal.

Relay 421 in releasing opens the energizing circuit of relay 101 causing it to release. Relay 101 in releasing opens at its right front contact the energizing circuit of slow release relay 112. Before relay 112 can release, however, a circuit is completed from battery, left front contact of relay 112, winding of relay 103, outer right back contact of relay 104, inner right back contact of relay 101 to ground on the left front contact of relay 102. Relay 103 operates and completes a locking circuit for itself from battery, through its inner left front contact and winding to ground as previously described. When relay 112 finally releases, a circuit is completed from battery, inner left front contact of relay 103, left winding of relay 110 to ground on the right back contact of relay 112. Relay 110 operates and completes a circuit for operating relays 311 and 201 for selecting a special coin sender. This circuit may be traced from battery, winding of relay 311, conductor 232, winding of relay 201, conductor 123, outer left front contact of relay 110, inner right back contact of relay 101 to ground on the left front contact of slow release relay 102, which has not yet released as a result of the release of relay 112. Relay 201 operates and at its outer left front contact completes a circuit for reenergizing slow release relay 102 before it can release. The operation from hereon for returning a coin and returning the switches to normal is the same as previously described for the return of the coin after the termination of a free line call.

If a call should be abandoned before a preliminary coin test has been completed and before relay 411 is operated, a coin inserted in the coin box will be returned to the subscriber, as previously described. However, if the coin is stuck and is not returned by the charge of negative current over the tip side of the line when relay 611 operates, relay 624 will be energized upon the subsequent operation of relay 615, as previously described, except that the circuit through the left winding of relay 624 will extend over the tip side of the calling line through the recording sender instead of through the special coin sender. Relay 624, in operating, operates relay 626, which in turn provides a

circuit through its inner right front contact for holding relays 609 and 629 operated. With relay 629 operated, relay 413 is unable to operate since its energizing circuit is opened at the back contact of relay 629. While relay 413 remains unoperated, release relay 403 is unable to operate and release any part of the connection since its energizing circuit is opened at the front contact of relay 413. With relay 626 operated and marginal relay 602 unoperated, a circuit is completed from battery, windings of marginal relay 416 and relay 415 in series, conductor 525, conductor 515 of horizontal link 560, conductor 662, left front contact of relay 626, inner right back contact of relay 602 to ground through the resistance 663. Relay 415 operates, but marginal relay 416 does not operate since resistance 663 is included in the circuit. With relay 415 operated, a circuit is completed from battery, signal lamp 412, front contact of relay 415, back contact of relay 416 to interrupted ground. Signal lamp 412 flashes and signals an operator that the connection is stuck as a result of a stuck coin on coin return.

If a coin is stuck on coin return after a satisfactory preliminary coin test wherein relay 411 is operated, the recording sender, coin control collector and coin control circuit are all dismissed and returned to normal and a special coin sender connected to the district selector, as previously described. Thereupon a signal lamp 664 is flashed to signal the operator that the special coin sender and the connection are stuck on coin return in the same manner as described for a stuck coin on return condition upon the termination of a free line call.

If a call for which no coin has been deposited in a coin box is abandoned after preliminary test, or more specifically after the operation of relay 605, the switches used in extending the connection are returned to normal as follows: Relay 618 deenergizes as a result of its energizing circuit being opened at the subscriber's station. The release of relay 618 completes a circuit from battery, outer right back contact of relay 608, right back contact of relay 618, winding of relay 621, inner right front contact of relay 605, to ground on the front contact of relay 601. Relay 621 operates and in so doing completes a circuit for operating release relay 403. This circuit may be traced from battery, right winding of relay 403, inner right back contact of relay 408, conductor 526, conductor 516 of horizontal link 560, conductor 622, back contact of relay 626, inner right front contact of relay 621, outer left front contact of relay 604, inner left back contact of relay 608, outer left back contact of relay 616, inner right front contact of relay 605, to ground on the front contact of relay 601. When relay 403 oper-

ates, it completes a holding circuit for itself through its right winding and inner right front contact to ground on the middle right front contact of relay 421. Relay 403 in operating attracts its innermost right back contact, thereby opening the energizing circuit of relay 404, which deenergizes. Relay 403 in operating, also opens at its left back contact the holding circuit of relay 421. When relay 404 deenergizes, it opens the holding circuit of relay 401, which releases. Relay 401 in releasing, in turn causes the release of relay 423. Relay 423 in releasing, opens the energizing circuit of relay 421, which releases. Relay 404 in releasing, also opens the energizing circuit of start relay 502, which deenergizes and causes the coin control connector circuit to release and return to normal. With the release of the coin control connector circuit, holding relay 601 in the coin control circuit is released causing the coin control circuit to be returned to normal as previously described.

With relay 421 released, all relays in the recording sender are released and the recording sender returned to normal. Relay 421 in releasing, also removes holding ground from the sender selector switch circuit and the district selector switch circuit and the line switch circuit, causing these circuits to release. With the release of the district selector circuit, holding ground for the line switch circuit and all switches subsequent to the district selector switch circuit is disconnected, causing these switches to return to normal as previously described.

Non-coin operation.—If a call should be originated over a non-coin subscriber's line, when the subscriber removes the receiver from the switchhook at substation 20 the vertical magnets 31 and 36 are operated and the talking leads 28 and 29 from substation 20 are connected through the line switch frame 50 and the connecting leads 42 and 43 to the non-coin district selector circuit 150, as described in the patent to S. B. Williams, hereinbefore referred to.

Vertical magnet 36 in operating, completes a circuit for operating relays 204 and 301, which cause the operation of the sender selector for the purpose of attaching an idle sender to the non-coin district selector 150. The circuit for operating relays 204 and 301 may be traced from battery, winding of relay 301, conductor 251, winding of relay 204, conductor 135, outer right back contact of relay 154, back contact of relay 152, inner back contact of relay 151 to ground on the front contact of vertical magnet 36. Relays 204 and 301 operate and cause the operation of sender selector 300 which attaches an idle recording sender in the same manner as previously described for the establishment of a connection when a call originates on a coin subscriber's line.

Relay 204 operates and completes a holding circuit for itself and relay 301 from battery through the windings of relays 301 and 204 in series, inner left front contact of relay 204, conductor 136, outer right back contact of relay 151, inner right back contact of relay 154, inner right back contact of relay 151, to ground on the front contact of relay 36. With relay 204 operated, a circuit is completed for operating relay 162 from battery, winding of relay 162, conductor 137, to ground on the outer left front contact of relay 204. Relay 162 operates and completes at its outer right front contact an obvious circuit for operating relay 152. Relay 152 in operating, opens at its back contact the initial energizing circuit of relay 204 and transfers holding ground from the front contact of vertical magnet 36 to its right front contact for holding the line switch 50 and the relays 301 and 204 operated. With relay 152 operated, a circuit is completed from battery, inner front contact of relay 162, winding of relay 153, outer right back contact of relay 151, inner right back contact of relay 154, to ground on the front contact of relay 152. Relay 153 operates in this circuit and at its inner left front contact completes a locking circuit for itself from battery, its inner left front contact and winding, to ground on the front contact of relay 152 over the circuit just described. When relay 153 operates, it completes a circuit for operating supervisory relay 163 which may be traced from ground through the lower left winding of repeating coil 170, outer right front contact of relay 153, inner left back contact of relay 154, outer left back contact of relay 151, conductor 42, through the line switch 50 to conductor 28 through the subscriber's station 20, conductor 29, through the line switch 50, conductor 43, inner left back contact of relay 151, winding of relay 163, to battery through the lower right winding of repeating coil 170. Supervisory relay 163 operates and provides an additional holding ground for relay 162.

As soon as the trunk vertical magnet 336 operates for connecting an idle sender with the non-coin district selector, a circuit is completed for operating relay 151 from battery, conductor 247, contacts and conductor of horizontal link 375, conductor 445, to ground on the lowermost front contact of trunk vertical magnet 336. Relay 151 operates and at its outer right back contact opens the holding circuit of relays 204 and 301, causing these relays to release, and at its left hand contacts opens the energizing circuit for relay 163, causing this relay to deenergize. Relay 151 in operating also completes a holding circuit for relay 162 through its inner right front contact and the front control of relay 152 to ground. With re-

lays 204 and 163 released, the initial energizing circuit for relay 162 is opened, but relay 162 remains operated over its holding winding.

When the sender is connected to the district selector circuit, pulsing relay 401 is operated in a circuit over the calling subscriber's line and relays 423 and 421 are in turn successively operated. With relay 421 operated, as soon as the thousands series of pulses are registered, relay 808 operates and completes a circuit for operating relay 405, which operates and causes district selection to be made, whereupon the district marker (not shown) releases and connects ground to lead 1451 for operating relay 425.

Since there is no ground such as 240 connected to the inner right front contact of relay 204, relay 407 is not operated and hence a circuit is completed upon the registration of the units series of pulses from ground on the inner left front contact of relay 421, outer left back contact of relay 403, front contact of units register relay 927, back contact of relay 424, front contact of relay 425, back contacts of relays 418, 409, 410 and 427 in series, back contact of relay 407, back contact of relay 406, conductor 455 to battery for operating the line marker in the sender register circuit (not shown) sender connector (not shown).

With the operation of the line marker sender connector, the talking connection between the calling and called subscribers is established and the switches used in establishing the connection returned to normal after the talking connection in the same manner as described in the patent to S. B. Williams, No. 1,517,331.

What is claimed is:

1. In a telephone exchange system, calling subscribers' lines equipped with charging mechanisms, other calling subscribers' lines not equipped with charging mechanism, means for extending a connection from any of said calling lines to a called line, controlling means commonly available to any of said calling lines normally arranged for controlling the extension of said connection on a no charge operating basis, and discriminating means associated with said charge lines for causing said controlling means to control the establishment of a connection on a charge operating basis when said controlling means is associated with one of said charge lines.

2. In a telephone exchange system, calling subscribers' lines equipped with charging mechanisms, other calling subscribers' lines not equipped with charging mechanisms, connecting circuits common to said charge lines, connecting circuits common to said no charge lines, automatic switches for extending a connection from any of said connecting circuits to a called line, means

common to said connecting circuits arranged to control the extension of said connection upon a no charge basis, and discriminating means for causing said controlling means to control the establishment of a connection on a charge basis when said controlling means is associated with one of said first mentioned connecting circuits.

3. In a telephone exchange system, calling lines equipped with charging mechanisms, calling lines not equipped with charging mechanisms, connecting circuits common to said charge lines, connecting circuits common to said no charge lines, automatic switches for extending a connection from a calling line to a called line, means common to said connecting circuits arranged to control the extension of said connection on a no charge operating basis, and means individual to each of said first mentioned connecting circuits for causing said controlling means to control the establishment of said connection on a charge operating basis when said controlling means is associated with one of said first mentioned connecting circuits.

4. In a telephone exchange system, calling subscribers' lines equipped with coin devices, calling subscribers' lines not equipped with coin devices, means for extending a connection from any one of said calling lines to a called line, means commonly available to any of said calling lines for controlling the extension of said connection, said controlling means arranged to extend said connection without interruption when a call originates at a calling subscriber's non-coin line, and means associated with said coin lines and cooperating with said controlling means to arrest the extension of said connection when a call originates on a subscriber's coin line until after the deposit of a coin in the coin device individual to such line.

5. In a telephone exchange system, calling subscribers' coin and non-coin lines, a coin device individual to each of said coin lines, means for extending a connection from any one of said calling lines to a called line, means commonly available to any of said calling lines for controlling the extension of said connection, said controlling means arranged to extend said connection without interruption when a call originates on a calling subscriber's non-coin line and means associated with said coin lines and cooperating with said controlling means to arrest the extension of said connection when a call originates on a subscriber's coin line, and means associated with said controlling means for causing a resumption of the extension of said connection upon the deposit of a coin in the coin device individual to the calling subscriber's coin line.

6. In a telephone exchange system, calling subscribers' coin and non-coin lines, connecting circuits common to said non-coin

lines, connecting circuits common to said coin lines, automatic switches for extending a connection from any of said connecting circuits to a called line, means commonly available to any of said connecting circuits for controlling the extension of a connection to a called subscriber's line without interruption when said controlling means is connected with one of said first mentioned connecting circuits, means individual to each of said second mentioned connecting circuits for causing said controlling means to arrest the extension of said connection when said controlling means is connected with one of said second mentioned connecting circuits, and means individual to said controlling means for causing said controlling means to resume the extension of said connection after the deposit of a coin in the coin device individual to the calling subscriber's coin line.

7. In a telephone exchange system, calling subscribers' coin and non-coin lines, a coin device individual to each of said coin lines, automatic switches for extending a connection from said calling lines to a called line, means commonly available to said calling lines for controlling the extension of connections both from coin and non-coin lines, means for arresting the extension of a connection when a call originates on a calling subscriber's coin line, and means for rendering said arresting means ineffective after the deposit of a coin in the coin device individual to said calling subscriber's coin line.

8. In a telephone exchange system, calling subscribers' coin and non-coin lines, a coin device individual to each of said coin lines, automatic switches for extending a connection from said calling lines to said called line, means commonly available to said calling lines for controlling the extension of connections both from coin and non-coin lines, means for arresting the extension of a connection when a call originates on a calling subscriber's coin line, and means for resuming the extension of said connection upon the deposit of a coin in the coin device individual to said calling subscriber's coin line.

9. In a telephone exchange system, calling subscribers' coin and non-coin lines, a coin device individual to each of said calling subscriber's coin lines, automatic switches for extending a connection from any of said calling lines to a called line, means commonly available to said calling lines for controlling the extension of connections both from coin and non-coin lines to a called line, means associated with said coin lines and cooperating with said controlling means to arrest the extension of a connection when the call originates on a calling subscriber's coin line, and means for resuming the extension of said connection when a coin is

deposited in the coin device individual to the calling subscriber's line.

10. In a telephone exchange system, calling subscribers' coin and non-coin lines, a coin device individual to each of said calling subscriber's coin lines, connecting circuits commonly available to any of said coin lines, connecting circuits commonly available to any of said non-coin lines, automatic switches for extending a connection from any of said connecting circuits to a called line, means commonly available to any of said connecting circuits for controlling the extension of a connection from either a coin or non-coin line to a called line, discriminating means individual to each of said first mentioned connecting circuits for causing said controlling means to discriminate in its operation between a calling subscriber's coin line and a calling subscriber's non-coin line, said controlling means including means under the control of said discriminating means for arresting the extension of a connection to a called subscriber when said controlling means is associated with one of said first mentioned connecting circuits, and means for rendering said arresting means ineffective after the deposit of a coin in the coin device individual to the calling subscriber's coin line.

11. In a telephone exchange system, calling subscribers' coin and non-coin lines, a coin device individual to each of said coin lines, connecting circuits commonly available to said coin lines, connecting circuits commonly available to said non-coin lines, automatic switches for extending a connection from any of said connecting circuits to a called line, means commonly available to said connecting circuits for controlling the extension of a connection from either a coin or a non-coin line to a called line, a plurality of means for governing the operation of said coin device, said controlling means including means for arresting the extension of a connection to a called line when a call originates on a calling subscriber's coin line, means for associating one of said governing means with said controlling means, and means for resuming the extension of said connection under the control of said associated governing means after the deposit of a coin in the coin device individual to said calling subscriber's coin line.

12. In a telephone exchange system, calling subscribers' coin and non-coin lines, a coin device individual to each of said coin lines, connecting circuits common to said coin lines, connecting circuits common to said non-coin lines, automatic switches for extending a connection from any of said connecting circuits to a called line, a plurality of means commonly available to said connecting circuits for controlling the extension of a connection to a called line, means

for associating one of said plurality of controlling means with any of said connecting circuits, a plurality of means for governing the operation of said coin devices, means for arresting the extension of said connection when said controlling means is associated with one of said first mentioned connecting circuits, means individual to each of said first mentioned connecting circuits for operating said arresting means, a connecting switch, means under the control of said arresting means for operating said connecting switch to connect one of said plurality of governing means to said associated controlling means, and means for rendering said arresting means ineffective under the control of said connected governing means.

13. In a telephone exchange system, calling subscribers' coin and non-coin lines, a coin device individual to each of said coin lines, connecting circuits common to said coin lines, connecting circuits common to said non-coin lines, automatic switches for extending a connection from any of said connecting circuits to a called line, a plurality of means commonly available to any of said connecting circuits for controlling the extension of a connection to a called line, means for associating any of said plurality of controlling means with any of said connecting circuits, a plurality of means for governing the operation of said coin devices, means for arresting the extension of said connection when said controlling means is associated with one of said first mentioned connecting circuits, means individual to each of said first mentioned connecting circuits for operating said arresting means, a connecting switch, means under the control of said arresting means for operating said connecting switch to connect one of said plurality of governing means to said associated controlling means, means for rendering said arresting means ineffective under the control of said connected governing means, and means under the control of said last mentioned means for releasing said connected governing means.

14. In a telephone exchange system, calling subscribers' coin lines, a coin device individual to each of said lines, automatic switches for extending a connection from said calling lines to a called line, means commonly available to said calling lines for controlling the establishment of said connection, means for governing the operation of said coin device, means under the control of said controlling means for associating said governing means with the coin device individual to a calling line before the establishment of said connection, and means independent of said controlling means for associating the governing means with said coin device upon the termination of said connection.

15. In a telephone exchange system, calling subscribers' coin lines, a coin device individual to each of said calling lines, automatic switches for extending a connection from any of said calling lines to a called line, means for controlling the extension of said connection, means for governing the operation of the coin device individual to a calling line, means under the control of said controlling means for associating said governing means with said coin device at one time, and means independent of said controlling means for associating said governing means with said coin device at another time.

16. In a telephone exchange system, calling subscribers' coin lines, a coin device individual to each of said calling lines, automatic switches for establishing a connection from any of said calling lines to a called line, means for controlling the establishment of said connection, means for governing the operation of the coin device of the calling line, means under the control of said controlling means for associating said governing means with said coin device for the purpose of controlling said controlling means, and means independent of said controlling means for associating said governing means with said coin device for the purpose of collecting or returning a coin upon the termination of said connection.

17. In a telephone exchange system, calling subscribers' coin lines, a coin device individual to each of said calling lines, automatic switches for establishing a connection from any of said calling lines to a called line, means for controlling the establishment of said connection, a plurality of means for governing the operation of said coin devices, means under the control of said controlling means for associating an idle one of said plurality of governing means with the coin device of a calling line for the purpose of controlling said controlling means, means under the control of said coin device for disassociating said governing means from said coin device, and means independent of said controlling means for associating said governing means with said coin device upon the termination of said connection for the purpose of collecting or returning a coin.

18. In a telephone exchange system, calling subscribers' coin lines, a coin device individual to each of said calling lines, automatic switches for establishing connections from said calling lines to a called line, means for controlling the establishment of any of said connections, a plurality of coin control circuits, means under the control of said controlling means for associating one of said coin control circuits with the coin device of a calling line before the completed establishment of a connection, means under the

control of said coin device for disassociating said coin control circuit before the completed establishment of the connection, and means independent of said controlling means for associating one of said plurality of coin control circuits with said coin device upon the termination of said connection.

19. In a telephone exchange system, calling subscribers' coin lines, a coin device individual to each of said calling lines, automatic switches for establishing a connection from any of said calling lines to a called line, a plurality of means for controlling the establishment of said connection, a plurality of coin control circuits separate from said controlling means, a plurality of coin control connecting circuits, a sender selector switch, means for causing said selector switch to associate one of said plurality of controlling means with a calling line, means under the control of said associated controlling means for associating one of said plurality of coin control circuits with the coin device of a calling line, means for disassociating said associated controlling means upon the establishment of said connection, means for causing said selector switch to associate one of said plurality of coin control connecting circuits with said calling line upon the termination of said connection, and means under the control of said coin control connecting circuit for associating one of said plurality of coin control circuits with said coin device.

20. In a telephone exchange system, calling subscribers' coin lines, a coin device individual to each of said lines, automatic switches for establishing a talking connection between any of said calling lines and a called line, a plurality of means for controlling the establishment of said talking connection, a plurality of coin control connecting circuits, a selector switch common to said calling lines, means for causing said selector switch to connect one of said plurality of controlling means to a calling line, a plurality of coin control circuits, a connecting switch, means under the control of said connected controlling means for causing said connecting switch to connect an idle one of said plurality of coin control circuits to said controlling means, means for disconnecting said connected coin control circuits upon the deposit of a coin in the coin device of the calling line, means for disconnecting said connected controlling means upon the establishment of said talking connection, means for causing said selector switch to associate one of said plurality of coin control connecting circuits with said calling line upon the termination of a connection, and means under the control of said associated coin control connecting circuit for causing said connecting switch to associate one of said plurality of

coin control circuits with said calling line.

21. In a telephone exchange system, calling subscribers' coin lines, connecting circuits common to said calling lines, a selector switch common to said connecting circuits, sender mechanisms, coin control connecting circuits, means individual to each of said first mentioned connecting circuits for causing said selector switch to select an idle one of said sender mechanisms, coin control circuits, means under the control of said selected sender mechanism for associating one of said coin control circuits with one of said calling lines, coin control connecting circuits, means individual to each of said first mentioned connecting circuits for causing said selector switch to select a coin control connecting circuit upon the termination of said connection, and means under the control of said selected coin control connecting circuit for associating one of said coin control circuits with said calling line.

22. In a telephone exchange system, calling subscribers' coin lines, automatic switches, a sender selector switch, a plurality of sender mechanisms commonly available to said sender selector switch, a plurality of coin control connecting circuits commonly available to said sender selector switch, a plurality of coin control circuits commonly available to both said sender mechanisms and said coin control connecting circuits, means for causing said sender selector switch to select an idle one of said plurality of sender mechanisms at one time, means for causing said sender selector switch to select an idle one of said coin control connecting circuits at another time, and means operative when one of said sender mechanisms or one of said coin control connecting circuits are selected, for connecting one of said plurality of coin control circuits to said selected mechanism or to said coin control connecting circuit, respectively.

23. In a telephone exchange system, calling subscribers' coin lines, connecting circuits common to said calling lines, automatic switches, a sender selector switch, a plurality of sender mechanisms, for controlling said automatic switches, a plurality of coin control connecting circuits, a plurality of coin control circuits, means individual to each of said first mentioned connecting circuits for causing said sender selector switch, to select one of said plurality of sender mechanisms, means individual to each of said first mentioned connecting circuits for causing said sender selector to select one of said plurality of coin control connecting circuits, and means operative upon the selection of either of said selected sender mechanism or said selected coin control connecting circuits for associating one

of said plurality of coin control circuits with a calling line.

24. In a telephone exchange system, a calling subscriber's coin line equipped with a coin device, a connecting circuit, automatic switches, a sender selector switch, a plurality of sender mechanisms, for controlling said automatic switches, a plurality of coin control connecting circuits, a plurality of coin control circuits, means individual to said connecting circuit for causing said sender selector switch to select an idle one of said sender mechanisms, means common to both said sender mechanism and said coin control connecting circuits for associating one of said plurality of coin control circuits with said calling line under the control of said selected sender mechanism, means for disassociating said controlling means upon the deposit of a coin in said coin device, means for releasing said selected sender mechanism, other means individual to said connecting circuit for causing said sender selector switch to subsequently select one of said plurality of coin control connecting circuits, said common means arranged to associate one of said plurality of coin control circuits with said calling line under the control of said selected coin control connecting circuit.

25. In a telephone exchange system, calling subscribers' coin lines, connecting circuits common to said coin lines, means for connecting one of said connecting circuits with a calling subscriber's coin line, automatic switches for establishing a talking connection to a called line, a sender selector switch, a plurality of sender mechanisms common to said sender selector switch for controlling said automatic switches, a plurality of coin control connecting circuits common to said sender selector switch, means individual to said connecting circuits for causing said selector switch to select one of said plurality of sender mechanisms, means for releasing said sender mechanism upon the establishment of said talking connection, means for causing said sender selector switch to select and connect one of said plurality of coin control connecting circuits to said connected connecting circuit upon the termination of said talking connection, and means individual to said connected connecting circuit for controlling said last mentioned means.

26. In a telephone exchange system, calling subscribers' coin lines, district selector switch circuits common to said calling lines, means for connecting one of said district selector switch circuits to a calling subscriber's coin line, automatic switches for extending a talking connection from any of said district selector switch circuits to a called line, a selector switch commonly available to said district selector switch circuits,

sender mechanisms and coin control connecting circuits commonly available to said selector switch, said selector switch normally arranged to select and connect one of said sender mechanisms to said connected district selector switch circuit under control of said connected district selector switch circuit, means for releasing said selected sender mechanism upon the establishment of said connection, and means responsive to the termination of said connection for causing said selector switch to select and connect one of said coin control connecting circuits to said connected district selector switch circuit.

27. In a telephone exchange system, subscribers' coin lines, district selector switch circuits common to said calling lines, means for connecting one of said district selector switch circuits with one of said calling lines, a selector switch, a plurality of sender mechanisms common to said selector switch, a plurality of coin control connecting circuits common to said selector switch, means responsive to a calling subscriber taking the receiver off the switchhook to cause said selector switch to select and connect an idle one of said sender mechanisms with said connected district selector switch circuits and means responsive to the termination of said connection to cause said selector switch to select and connect an idle one of said coin control connecting circuits to said connected district selector switch circuit.

28. In a telephone exchange system, calling subscribers' coin lines, district selector switch circuits commonly available to said calling subscribers' coin lines, a sender selector switch common to said district selector switch circuits, sender mechanisms and coin control connecting circuits commonly available to said sender selector switch, means individual to said sender selector switch for determining whether a sender selector switch will select a sender mechanism or a coin control connecting circuit, and means individual to each of said district selector switch circuits for controlling said determining means.

29. In a telephone exchange system, subscribers' coin and non-coin lines, district selector switch circuits common to said coin lines, district selector switch circuits common to said non-coin lines, a selector switch, a plurality of sender mechanisms common to said selector switch, a plurality of coin control connecting circuits common to said selector switch, means individual to each of said district selector switch circuits for causing said selector switch to select one of said plurality of sender mechanisms, means individual to each of said district selector switch circuits for disconnecting said sender mechanism, means individual to each of said first mentioned district selector switch circuits for thereafter causing said selector switch to

select one of said coin control connecting circuits, and means under the control of each of said first mentioned district selector switch circuits for causing said sender selector switch to discriminate in its selection between a sender mechanism and a coin control connecting circuit.

30. In a telephone exchange system, a calling subscriber's coin line, a coin device individual to said calling line, a connecting circuit, automatic switches for extending a connection to a called subscriber, a sender mechanism, means for associating said sender mechanism with said calling line, a plurality of coin control circuits means individual to said sender mechanism for associating one of said plurality of coin control circuits with said coin device, means responsive to the depositing of a coin in said coin device for releasing said associated coin control circuit, means responsive to the establishment of said connection for releasing said sender mechanism, means responsive to the termination of said connection for causing said sender selector to associate said coin control connecting circuit with said calling line, means under the control of said coin control connecting circuit for associating one of said coin control circuits with said coin device, and means for operating said coin device to collect or return said coin under the control of said coin control circuit.

31. In a telephone exchange system, a calling subscriber's coin line, a coin device individual to said line, a connecting circuit, automatic switches for extending a connection to a called subscriber for which no charge is made, a sender mechanism, means for associating said sender mechanism with said calling line, a coin control circuit, means individual to said sender mechanism for associating said coin control circuit with said coin device, means responsive to the deposit of a coin in said coin device for releasing said coin control circuit, means responsive to the establishment of said connection for releasing said sender mechanism, a coin control connecting circuit, means responsive to the termination of said connection for causing said selector switch to associate said coin control connecting circuit with said calling line, and means in said coin control circuit under the joint control of said connecting circuit and coin control connecting circuits to cause said coin device to return said coin to the calling subscriber.

32. In a telephone exchange system, calling subscribers' coin lines, a coin device individual to each of said coin lines, automatic means for extending a connection from a calling subscriber's coin line to a called line, a plurality of means for controlling the extension of said connection, a selector switch arranged to associate one of said plurality

of controlling means with said calling subscriber's coin line, a plurality of coin control circuits, means associated with said selected controlling means for associating one of said plurality of coin control circuits with the coin device individual to said calling subscriber's coin line, said coin control circuit comprising means to determine whether a coin has been deposited in the coin device individual to the calling line, means for causing said coin device to return a deposited coin if the calling subscriber should abandon the connection before said coin control circuit has determined whether a coin has been deposited or not, and means responsive to said last mentioned means for disestablishing said connection.

33. In a telephone exchange system, a calling subscriber's coin line, a coin device individual to said line, automatic switches for extending a connection to a called line, a plurality of means for controlling the extension of said connection, a selector switch arranged to associate one of said plurality of controlling means with said calling line, a plurality of coin control circuits, means for associating an idle coin control circuit with said associated controlling means, said coin control circuit comprising means for determining the presence or absence of a coin in said coin device, and means for returning a deposited coin to the calling subscriber if the calling subscriber restores his receiver to its switchhook before said determining means has completely operated.

34. In a telephone exchange system, a calling subscriber's coin line, a coin device individual to said line, automatic switches for extending a connection to a called line, a plurality of means for controlling the extension of said connection, a selector switch arranged to associate one of said plurality of controlling means with said calling line, means individual to said controlling means for arresting the extension of said connection, a plurality of coin control circuits, means under the control of said associated controlling means for associating one of said plurality of coin control circuits with said coin device, said associated coin control circuit comprising means for determining the presence or absence of a coin in said coin device and means for rendering said arresting means ineffective if a coin is deposited in said coin device, means for disassociating said coin control circuit from said coin device, means individual to said controlling means for associating one of said plurality of said coin control circuit with said coin device a second time if the calling subscriber should abandon the connection before the called party answers and means individual to said second selected coin control circuit for causing said coin device to return the deposited coin to the calling subscriber.

In witness whereof, we hereunto subscribe our names this 19th day of March, A. D. 1924.

SAMUEL B. WILLIAMS.
EARL S. GIBSON.