

Oct. 1, 1946.

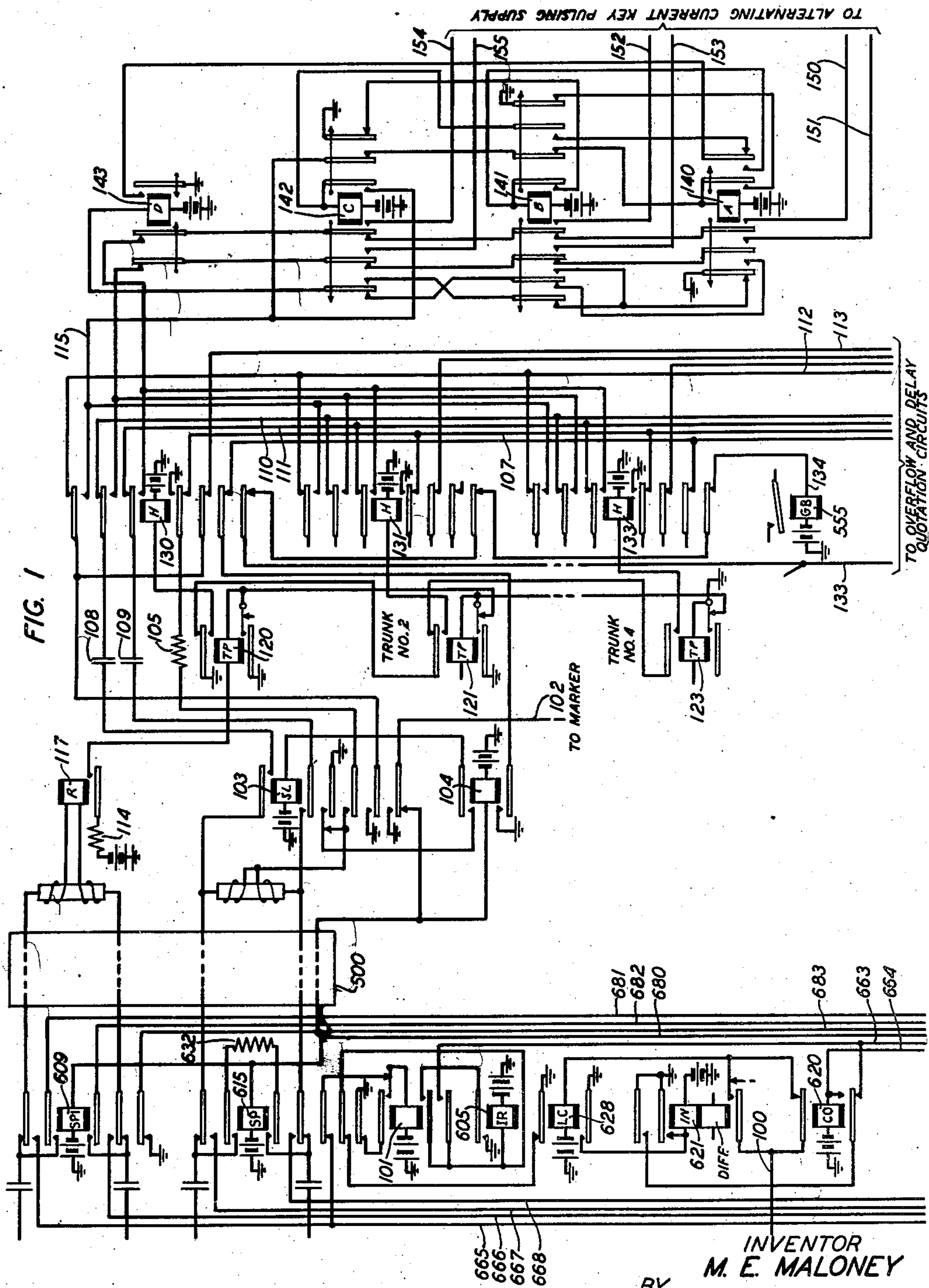
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2,408,432

TELEPHONE SYSTEM

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2 Sheets-Sheet 1



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TELEPHONE SYSTEM

2 Sheets-Sheet 2

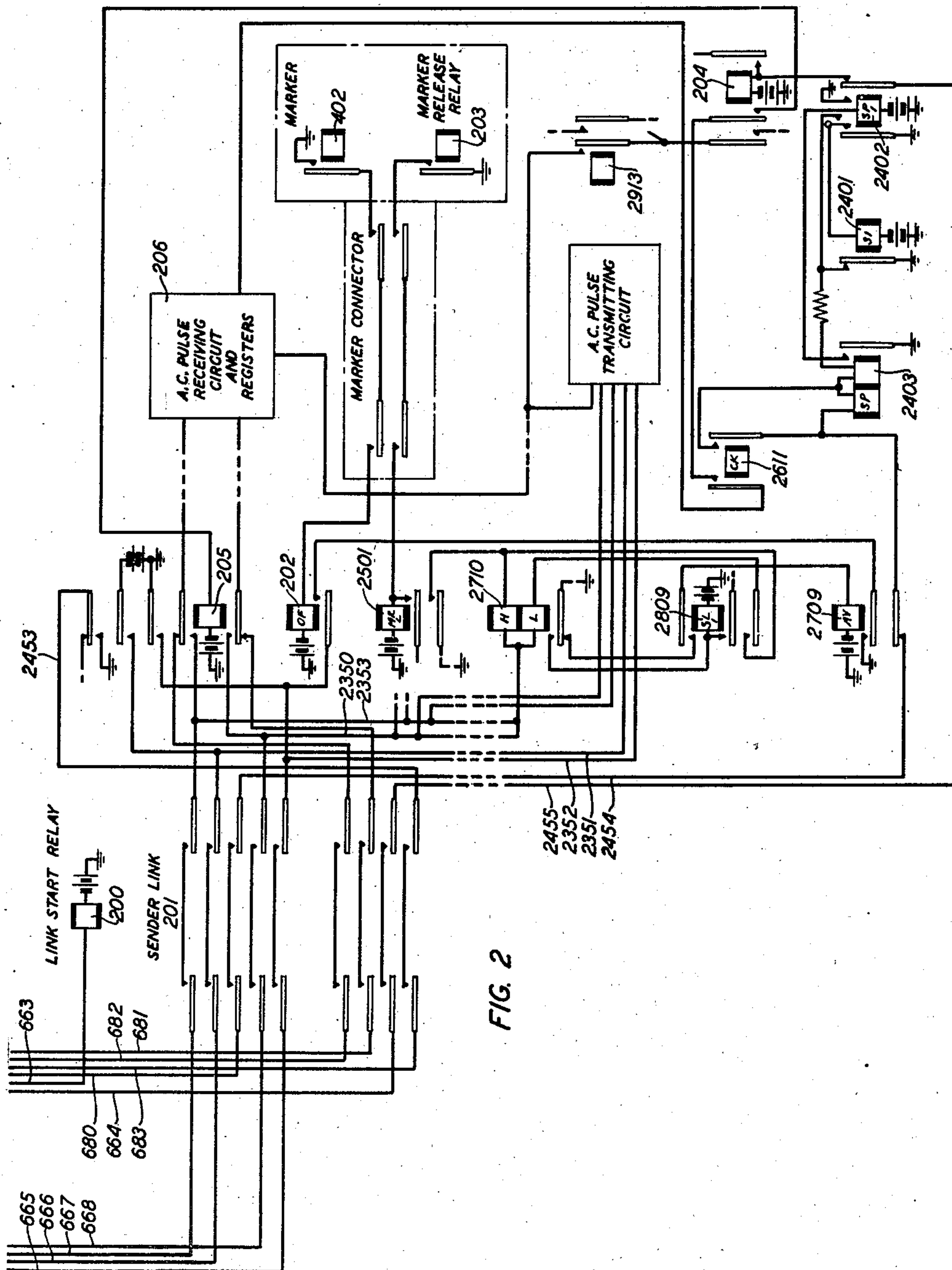


FIG. 2

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TELEPHONE SYSTEM

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Application May 23, 1945, Serial No. 595,301

11 Claims. (Cl. 179—27)

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This invention relates to toll telephone systems and has for its object to facilitate the completion of toll connections during busy calling periods.

More specifically, the invention contemplates an improvement on the automatic switching arrangements disclosed and claimed in the patent application, Serial No. 550,070, of B. McKim and O. Myers, filed August 18, 1944, patented Aug. 14, 1945, No. 2,382,893.

In that application is shown a toll office equipped with automatic switches of the cross bar type, in which calls incoming to the office are extended to outgoing trunks under the control of register senders and markers, the former of which receive the designation of the wanted subscriber either directly from the local toll operator or over the incoming trunk from the toll operator at the calling office.

During periods of normal traffic, the marker receives the designation of the wanted office from the sender, tests for and selects an idle trunk outgoing to that office, operates the necessary cross bar switches to connect the incoming trunk with the selected outgoing trunk and releases, having given the sender any information necessary for its further operation. However, if all of the trunks outgoing to the wanted office are busy, the marker connects the incoming trunk to one of a number of overflow trunks, individual to the wanted group of outgoing trunks, over which the calling toll operator receives a flashing overflow signal. When an outgoing trunk becomes idle, the rate of flashing is changed to indicate a reorder and the calling toll operator may make a new attempt to complete the call.

In accordance with the present invention means is provided whereby, when a call has been directed to an overflow trunk, the release of one of the corresponding group of outgoing trunks causes the overflow trunk to automatically transmit the designation of the outgoing trunk group to a sender connected with the associated incoming trunk.

Another feature of the invention lies in means for transmitting the reorder signal to a plurality of incoming trunks together with means to associate the designation transmitting means with a single calling trunk, changing the reorder signal back to an overflow signal for the other calling trunks.

Another feature of the invention lies in means to set up a record in an incoming trunk when that trunk has been connected to an overflow trunk. When the operator rerings in response to the reorder signal, a sender is attached to the

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trunk and a rehunt signal is transmitted to the sender. The rehunt signal causes the sender to arrange its circuits to receive pulses from the outgoing end of the trunk and also to prepare to transmit, if necessary, the proper designation for extending the call to an operator's position at the wanted office.

These and other features of the invention will be more clearly understood from a consideration of the following description read in connection with the drawings, in which:

Fig. 1 shows a part of an incoming trunk circuit, and an overflow trunk and code generator embodying the present invention; and

Fig. 2 show parts of a sender and a marker for carrying out the features of the invention.

The drawings are, in part, skeletonized showings of the circuits of the above-mentioned application of McKim and Myers. Reference is made to that application for a disclosure of the complete equipment and where possible the same reference characters have been employed. Reference numerals less than four hundred identify added equipment.

An incoming call, over a trunk such as shown at the left of Fig. 1, is indicated by the connection of ground to conductor 100 in response to the operation of a composite signaling circuit (not shown) under the control of the calling toll operator at the distant office. Ground on conductor 100 completes a circuit extending over a back contact of relay 620 to the winding of relay 628 and battery. Relay 628 closes an obvious circuit for relay 621 which locks to ground at its own contact, closes a holding circuit for relay 628 to conductor 100, and connects ground over a back contact of relay 620 to conductor 663 to operate the link start relay 200 and cause the operation of the sender link 201 to connect the trunk of Fig. 1 with an idle sender such as the one shown in part in Fig. 2.

When this connection is completed, a circuit is closed from battery through the windings of relays 609 and 615, conductor 680 through the sender link 201 to conductor 2454 and thence over a back contact of relay 2109, windings of relay 2403 to ground at the back contact of relay 2401. Relay 2403 operates in this circuit but relays 609 and 615 cannot, due to the high resistance of the left winding of relay 2403. Relay 2403 operates relay 2402 which operates relay 2401 and connects a substitute ground to the right winding of relay 2403. Relay 2402 connects ground to conductor 2455 which extends through the sender link 201 to conductor 664, winding of relay 620

and battery. Relay 620 operates, locks under the control of relay 621 and opens the start circuit of the sender link which is now held from the sender.

After the sender has received the class information from the trunk and adjusted itself in accordance therewith to receive the incoming pulses, relay 2611 is operated, short-circuiting the high resistance left winding of relay 2403 to permit relays 609 and 615 to operate. Relays 609 and 615 disconnect the incoming and outgoing line conductors, relay 609 extending the incoming conductors of the upper channel to conductors 681 and 682, while relay 615 bridges resistance 632 across the incoming tip and ring conductors of the lower channel. The outgoing tip and ring conductors of the upper channel are connected to conductors 665 and 666 while those of the lower channel are connected to conductors 667 and 668.

The operation of the sender in receiving the number of the wanted subscriber and transferring the office code to a marker takes place as described in the above-identified McKim-Myers patent. The marker identifies the group of trunks leading to the wanted office and attempts to test them. In the manner set forth in the McKim-Myers patent, if all of the trunks are busy, a relay such as relay 402, is immediately operated which causes the marker to test for an idle overflow trunk and operate the outgoing link switches 500 to connect the incoming trunk with the overflow trunk at the right of Fig. 1. The operation of relay 402 also transmits a signal to the sender which operates relay 202 to tell the sender that the call has been extended to an overflow trunk.

After the marker has tested the overflow trunk and found it idle it connects ground to conductor 102, closing a circuit over a back contact of relay 103 to the winding of relay 104 and battery. Relay 104 connects battery through the winding of relay 103 over a front contact of relay 104 and a make-before-break contact of relay 103 to the simplex circuit over the lower channel of the trunk, through switches 500 and contacts of relay 615 to conductors 667 and 668.

When the marker has completed its functions the marker release relay 263 is operated, in turn, operating relay 2501. Relay 2501 operates, locks and closes a circuit from ground over its lower contact, upper winding of relay 2710, over conductors 2353 and 2350 in parallel, through the sender link to conductors 667 and 668. If the connection has been completed, relay 2710 operates, in turn operating relay 2809 which operates, locks, and connects the low resistance lower winding of relay 2710 in parallel with the upper winding of relay 2710, reducing the resistance in series with relay 103 sufficiently to permit that relay to operate. Relay 103 locks under the control of relay 104 and extends the simplex circuit through resistance 105 and the back contact of relay 130 to conductor 107 to which interrupted ground is connected, at a rate to indicate an overflow condition, by the overflow circuit. Relay 103 also connects the tip and ring conductors of the lower channel through condensers 108 and 109 and over contacts of relay 130 to conductors 110 and 111 leading to a jack at the delay quotation board, the operation of which is fully disclosed in the McKim-Myers patent, previously mentioned. Relay 103 also connects ground over the back contact of relay 130 to conductors 112 and 113 to control the

functions of the overflow circuit. In addition it connects ground to conductor 102 to mark this overflow trunk busy to any marker which may be testing in this group.

In the sender, the connection of ground to the simplex circuit causes the release of relay 2710, closing a circuit from ground over the back contact of relay 2710, front contact of relay 2809 to the winding of relay 2709 and battery. Relay 2709 opens the operating circuit of relays 609 and 615, causing these relays to release. Since relay 202 was operated to tell the sender that the call had been extended to an overflow trunk, as soon as relay 615 releases, relay 2709 closes a circuit from ground over its front contact, front contact of relay 202, through the sender link 201 to conductor 665, back contact of relay 615, normal contacts and winding of relay 101 to battery. Relay 101 locks to ground at a back contact of relay 615. With relays 609 and 615 released the overflow trunk is connected to the incoming trunk and the overflow flashes are transmitted to the originating office. The release of the sender takes place as described in the above-identified McKim-Myers patent. In the manner above described, one to three other incoming trunks may be connected over contacts of relays 131, 133, etc. to the overflow trunk of this group.

When one of the outgoing trunks, in the group associated with the overflow trunk of Fig. 1, becomes idle, the rate of the flash transmitted over the trunk is changed as a reorder signal. As above noted, as many as four incoming trunks may be connected to the overflow circuit, each one having a pair of relays like relays 120 and 130. Conductor 107 to which the flashing ground is connected extends in parallel over back contacts of relays 130, 131, 133 to the trunks connected thereto and therefore four calling toll operators may observe the reorder signal and operate their composite signal circuits to attempt to seize the trunk which has become idle.

In the trunk circuit of Fig. 1, relays 620 and 621 are locked. The recall operation momentarily removes ground from conductor 100 releasing and reoperating relay 628. While relay 628 is released, it operates relay 605 over a back contact of relay 615. Since relay 101 was operated and locked, relay 605 now locks over the front contact of relay 101 and this locking ground is extended over a second front contact of relay 101 to the start conductor 663, operating the sender link to connect a sender with the trunk as previously described.

Since relay 620 is locked to ground at the contact of relay 621, ground appears on conductor 664 which is extended through the sender link 201 to conductor 2455 and over the back contact of relay 2402 to the winding of relay 204 and battery. Relay 204 operates in this circuit and locks so that it remains operated after relay 2402 opens its operating circuit.

When relay 2611 operates, with relay 204 operated, a circuit is closed from ground in the alternating current receiving circuit 206, front contact of relay 2611, front contact of relay 204, winding of relay 205 and battery. Relay 205 disconnects the receiving circuit 206 from the incoming end of the trunk and connects it to conductors 2350 and 2353, ready to receive pulses from the outgoing end of the trunk. Relay 205 also connects battery and ground to conductors 2352 and 2351.

When relays 609 and 615 are operated in the manner above described, they release relay 101

and open the holding circuit for the switches 500. However, at this time a substitute holding circuit for the outgoing link switches 500 and relay 104 is closed over conductor 683 through the sender link 201, conductor 2453, front contact of relay 205 to ground. With switches 500 held operated, the operation of relay 609 connects relay 117 over the upper channel to conductors 665 and 666, through the sender link to battery and ground over conductors 2351 and 2352, while relay 615 connects the tip and ring conductors of the lower channel as previously traced to conductors 2350 and 2353 which now extend to the pulse receiving circuit 206.

Relay 117 operates in the circuit traced, closing a circuit from battery through resistance 114, front contact of relay 117, winding of relay 120, and thence over a chain circuit including normal contacts of relays 121, 123, etc., to ground. Relay 120 operates and locks to ground at its lower front contact. At its upper back contact relay 120 disconnects ground from a chain circuit extending to relays 121 and 123 and closes an obvious circuit for relay 130.

It will be apparent that, if four of the trunks having access thereto, have connected with this overflow circuit when the reorder signal is given, the first operator to signal for rehunt will cause the operation of the associated relay of the group 120 to 123. The operation of a higher numbered relay prevents the operation of a lower numbered relay, although a still higher numbered relay might be operated later. However, the lowest numbered operated relay operates the associated relay in group 130 to 133 and prevents the operation of any other relay in the latter group.

Relay 130, in operating, disconnects the overflow trunk from the overflow circuit and connects the tip and ring conductors of the lower channel to the pulse generating relays 140 to 143. Relay 130 also connects steady ground to the simplex circuit over the lower channel as a hold signal to the sender. The circuit of the trunk group busy relay 555 is carried over the back contacts of relays 130, 131, 133, etc., so that, as soon as relay 130 operates, relay 555 releases to again direct an overflow flash to any other trunks which may be connected with the overflow circuit.

Relay 130 also disconnects ground, supplied by relay 103, from conductors 112 and 113 and extends it over conductor 115, back contacts of relays 142 and 141, to the winding of relay 140 and battery to start the pulse generation. Relay 140 operates and locks to ground at a back contact of relay 141. At its inner left contacts relay 140 connects the tip and ring conductors of the lower channel to conductors 150 and 151 leading to the alternating current supply circuit where they are connected to a source of two frequencies assigned to the first digit of the code representing the group of outgoing trunks associated with this particular overflow circuit.

Relay 140 closes a circuit over its front contact and the back contacts of relays 141 and 142 to the winding of relay 143 and battery. Relay 143, which is slow to operate, after an interval opens the pulsing circuit at its left contacts and at its right contact closes a circuit from ground, over the front contact of relay 140 to the winding of relay 141 and battery. Relay 141 operates in this circuit and locks to ground at the back contact of relay 142. At its inner right contacts, relay 141 transfers the pulsing circuit

to conductors 152 and 153 which are connected to a source supplying the frequencies representing the second digit of the code. At its left back contact relay 141 opens the circuit of relay 143 and that relay releases, reclosing the pulsing circuit. At its right back contacts, relay 141 opens the operating and locking circuits of relay 140 and that relay, being slow to release, releases after an interval.

When relay 140 closes its back contacts it completes a circuit from ground over its left back contact, front contact of relay 141, and the back contact of relay 142 for operating relay 143 which again operates after an interval to terminate the second pulse and close a circuit from ground over its right contact, back contact of relay 140, front contact of relay 141 to battery through the winding of relay 142. Relay 142 operates in this circuit, and locks over conductor 115 to ground supplied by relay 103. Relay 142 transfers the pulsing circuit to conductors 154 and 155 which are connected to frequencies representing the third digit of the office code. Relay 142 opens the circuit of relay 143 and that relay releases, reclosing the pulsing circuit. Relay 142 also opens the operating and locking circuits of relay 141 and that relay releases after an interval, closing an operating circuit for relay 143 which extends from ground over back contacts of relays 140 and 141 and over the front contact of relay 142. Relay 143 terminates the third pulse and the pulsing relays remain in this condition until the overflow circuit is released.

In the sender, the registration of the third digit releases relay 205, restoring the pulse receiving circuit to the incoming end of the trunk. The release of relay 205 also disconnects ground from conductor 2453, releasing the outgoing link switches 500 and restoring the relays 117, 120, 130, 142 and 143 to normal. Relay 205, in releasing, also disconnects battery and ground from conductors 2351 and 2352. The code registered by the pulse receiving circuit is transferred to the marker which now attempts to seize the trunk which became idle.

When the marker has determined the type of pulsing required by the wanted office, for example, alternating current key pulsing, it operates relay 2913 to arrange the sender for that type of pulsing and connect the proper pulse transmitting circuit to the outgoing end of the trunk. Since the called line number is not recorded in this sender, relay 204 sets up a circuit over a contact of relay 2913 to cause the transmitting circuit to transmit the digits 1-2-1 designating an operator's position to the wanted office.

When the call has been extended to the operator's position at the wanted office the sender is released and the trunk cut through so that the originating operator may pass the wanted line number and the call may be completed.

The invention has been described as employing alternating current key pulsing throughout and a three-digit office code. However, the sender disclosed in the McKim-Myers patent is also capable of receiving and transmitting direct current key pulses when it receives corresponding indications from the trunk and marker, and also will accept office codes containing more than three digits. It is therefore to be understood that, if desirable, direct current code pulsing might be employed by the code generator associated with the overflow trunks and also that additional code generating relays might be pro-

vided in connection with trunk groups requiring more code digits.

What is claimed is:

1. In a telephone system, a toll office, trunks incoming to said office, trunks outgoing from said office arranged in groups in accordance with office codes, each group including an overflow trunk individual thereto, control equipment, means responsive to a call over one of said incoming trunks for connecting control equipment with said trunk, means in said control equipment for registering an office code, means in said control equipment responsive to the registration of a code for extending said incoming trunk to an idle one of the corresponding group of outgoing trunks or to the overflow trunk individual thereto and thereupon releasing from said incoming trunk, means responsive to a recall over said incoming trunk to reconnect control equipment with said trunk and means in said overflow trunk for transmitting the code of the trunk group to said reconnected control equipment.

2. In a telephone system, a toll office, trunks incoming to said office, trunks outgoing from said office arranged in groups in accordance with office codes, each group including an overflow trunk individual thereto, control equipment, means responsive to a call over one of said incoming trunks for connecting control equipment with said trunk, means in said control equipment for registering an office code, means in said control equipment responsive to the registration of a code for extending said incoming trunk to an idle one of the corresponding group of outgoing trunks or to the overflow trunk individual thereto and thereupon releasing from said incoming trunk, means responsive to a recall over said incoming trunk to reconnect control equipment with said trunk and means in said overflow trunk responsive to said reconnection for transmitting the code of the trunk group to said reconnected control equipment.

3. In a telephone system, a toll office, trunks incoming to said office, trunks outgoing from said office arranged in groups in accordance with office codes, each group including an overflow trunk individual thereto, control equipment, means responsive to a call over one of said incoming trunks for connecting control equipment with said trunk, means in said control equipment for registering an office code, means in said control equipment responsive to the registration of a code for extending said incoming trunk to an idle one of the corresponding group of outgoing trunks or to the overflow trunk individual thereto and thereupon releasing from said incoming trunk, overflow indicating means operated in said trunk prior to the release of said control equipment if said trunk is connected to an overflow trunk, and means responsive to a recall over said incoming trunk if said overflow indicating means is operated to reconnect control equipment with said trunk.

4. In a telephone system, a toll office, trunks incoming to said office, trunks outgoing from said office arranged in groups in accordance with office codes, each group including an overflow trunk individual thereto, control equipment, means responsive to a call over one of said incoming trunks for connecting control equipment with said trunk, means in said control equipment for registering an office code, means in said control equipment responsive to the registration of a code for extending said incoming trunk to an idle one of the corresponding group of outgoing trunks or to the overflow trunk individual thereto and thereupon

releasing from said incoming trunk, overflow indicating means operated in said trunk prior to the release of said control equipment if said trunk is connected to an overflow trunk, means responsive to a recall over said incoming trunk if said overflow indicating means is operated to reconnect control equipment with said trunk, and means in said overflow trunk for transmitting the code of the trunk group to said reconnected control equipment.

5. In a telephone system, a toll office, trunks incoming to said office, trunks outgoing from said office arranged in groups in accordance with office codes, each group including an overflow trunk individual thereto, control equipment, means responsive to a call over one of said incoming trunks for connecting control equipment with said trunk, means in said control equipment for registering an office code, means normally effective to connect said registering means to the incoming end of said trunk, means in said control equipment responsive to the registration of a code over the incoming end of said trunk for extending said incoming trunk to an idle one of the corresponding group of outgoing trunks or to the overflow trunk individual thereto and thereupon releasing from said incoming trunk, means responsive to a recall over said incoming trunk to reconnect control equipment with said trunk, means responsive to said reconnection to connect said registering means to the outgoing end of said trunk, and means in said overflow trunk for transmitting the code of the trunk group to said reconnected control equipment.

6. In a telephone system, a toll office, trunks incoming to said office, trunks outgoing from said office arranged in groups in accordance with office codes, each group including an overflow trunk individual thereto, control equipment, means responsive to a call over one of said incoming trunks for connecting control equipment with said trunk, means in said control equipment for registering an office code, means normally effective to connect said registering means to the incoming end of said trunk, means in said control equipment responsive to the registration of a code over the incoming end of said trunk for extending said incoming trunk to an idle one of the corresponding group of outgoing trunks or to the overflow trunk individual thereto and thereupon releasing from said incoming trunk, overflow indicating means operated in said trunk prior to the release of said control equipment if said trunk is connected to an overflow trunk, means responsive to a recall over said incoming trunk if said overflow indicating means is operated to reconnect control equipment with said trunk, means responsive to said reconnection to connect said registering means to the outgoing end of said trunk, and means in said overflow trunk for transmitting the code of the trunk group to said reconnected control equipment.

7. In a telephone system, a toll office, trunks incoming to said office, trunks outgoing from said office, said outgoing trunks arranged in groups, an overflow trunk individual to each group, means effective when all of a group of outgoing trunks are busy to connect a plurality of incoming trunks to the overflow trunks individual to said group of outgoing trunks, means to transmit an overflow signal over said overflow trunk to said plurality of incoming trunks, means responsive to one of said group of outgoing trunks becoming idle to transmit a reorder signal over said overflow trunk to said plurality of incom-

ing trunks, means responsive to a recall over one of said incoming trunks to transmit an identification of said group of outgoing trunks to said one incoming trunk and means simultaneously effective to again transmit an overflow signal to the others of said plurality of incoming trunks.

8. In a telephone system, a toll office, trunks incoming to said office, trunks outgoing from said office, said outgoing trunks arranged in groups, an overflow trunk individual to each group, means effective when all of a group of outgoing trunks are busy to connect a plurality of incoming trunks to the overflow trunk individual to said group of outgoing trunks, means to transmit an overflow signal over said overflow trunk to said plurality of incoming trunks, means responsive to one of said group of outgoing trunks becoming idle to transmit a reorder signal over said overflow trunk to said plurality of incoming trunks, means responsive to a recall over one of said incoming trunks to transmit an identification of said group of outgoing trunks to said one incoming trunk, and means to automatically transmit an overflow signal to the others of said plurality of trunks during the transmission of said identification to said one trunk.

9. In a telephone system, a toll office, trunks incoming to said office, trunks outgoing from said office, said outgoing trunks arranged in groups, an overflow trunk individual to each group, means effective when all of a group of outgoing trunks are busy to connect a plurality of incoming trunks to the overflow trunk individual to said group of outgoing trunks, means to transmit an overflow signal over said overflow trunk to said plurality of incoming trunks, code generating means individual to said overflow trunk, means responsive to one of said group of outgoing trunks becoming idle to transmit a reorder signal over said overflow trunk to said plurality of incoming trunks, means responsive to a recall over one of said incoming trunks to connect said code generating means with said one incoming trunk to transmit an identification of said group of outgoing trunks to said one incoming trunk, and means under the control of said connecting means to automatically transmit an overflow signal to the others of said plurality of trunks during the transmission of said identification to said one trunk.

10. In a telephone system, a toll office, trunks incoming to said office, trunks outgoing from said office arranged in groups in accordance with office codes, each group including an overflow trunk individual thereto, control equipment, means responsive to a call over one of said incoming trunks for connecting control equipment with said trunk, means in said control equipment for registering an office code, means in said control

equipment responsive to the registration of a code for extending said incoming trunk to the corresponding overflow trunk if all of the outgoing trunks are busy and thereupon releasing from said incoming trunk, means to connect a plurality of other incoming trunks to said overflow trunk, means to transmit a flashing overflow signal over said overflow trunk to all of said incoming trunks, means responsive to one of said group of outgoing trunks becoming idle for transmitting a reorder signal over said overflow trunk to all of said incoming trunks, means responsive to a recall over one of said incoming trunks to reconnect control equipment with said one trunk, code generating means individual to said overflow trunk, means under the control of said control equipment to connect said code generating means with said one incoming trunk to transmit the code of the outgoing trunk group to said reconnected control equipment and means responsive to said code generator connecting means to again transmit said flashing overflow signal to said other incoming trunks.

11. In a telephone system, a toll office, trunks incoming to said office, trunks outgoing from said office arranged in groups in accordance with office codes, each group including an overflow trunk individual thereto, control equipment, means responsive to a call over one of said incoming trunks for connecting control equipment with said trunk, means in said control equipment for registering an office code, means in said control equipment responsive to the registration of a code for extending said incoming trunk to the corresponding overflow trunk if all of the outgoing trunks are busy and thereupon releasing from said incoming trunk, means to connect a plurality of other incoming trunks to said overflow trunk, means to transmit a flashing overflow signal over said overflow trunk to all of said incoming trunks, means responsive to one of said group of outgoing trunks becoming idle for transmitting a reorder signal over said overflow trunk to all of said incoming trunks, means responsive to a recall over one of said incoming trunks to reconnect control equipment with said one trunk, code generating means individual to said overflow trunk, means under the control of said control equipment to connect said code generating means with said one incoming trunk to transmit the code of the outgoing trunk group to said reconnected control equipment and means responsive to said code generator connecting means to automatically transmit said flashing overflow signal to said other incoming trunks during the operation of said code generating means.

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