May 24, 1949. G. A. ANDERSON 2,471,087

TOLL OPERATOR CONTROL FOR TELEPHONE COIN COLLECTORS

Filed April 9, 1946 3 Sheets-Sheet 1

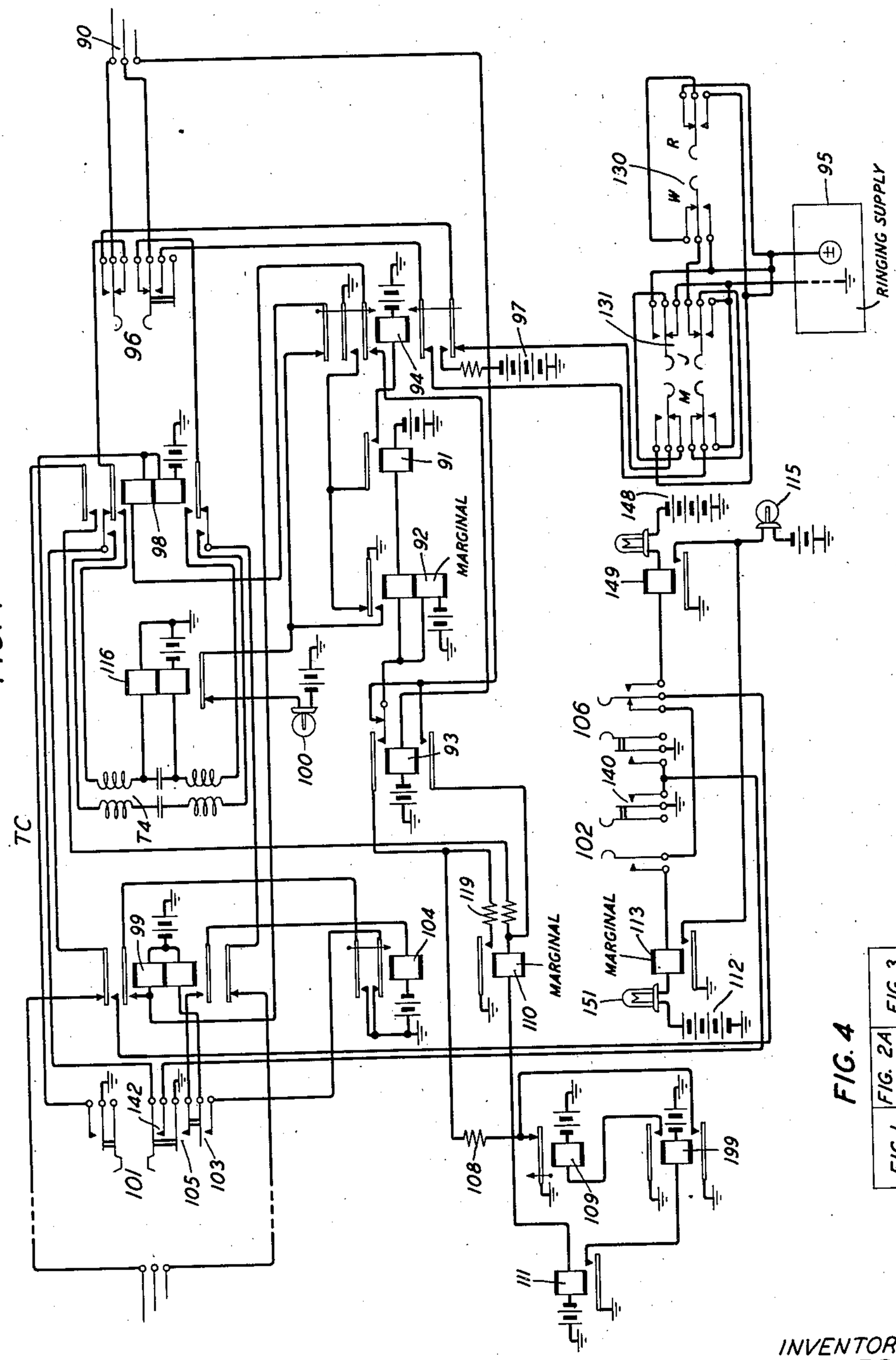


FIG. 1

FIG. 4

| | |
|---|---|
| FIG. 1 | FIG. 2A<br>FIG. 2B |
| | FIG. 3 |

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FIG. 2A

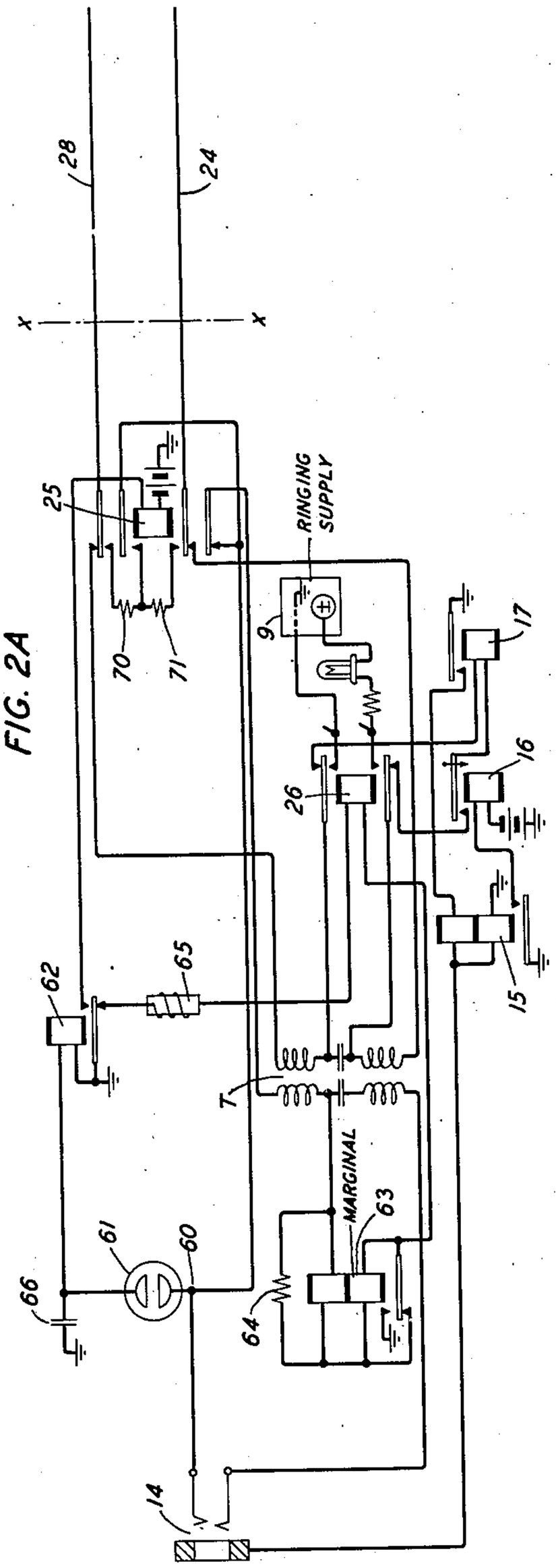


FIG. 2B

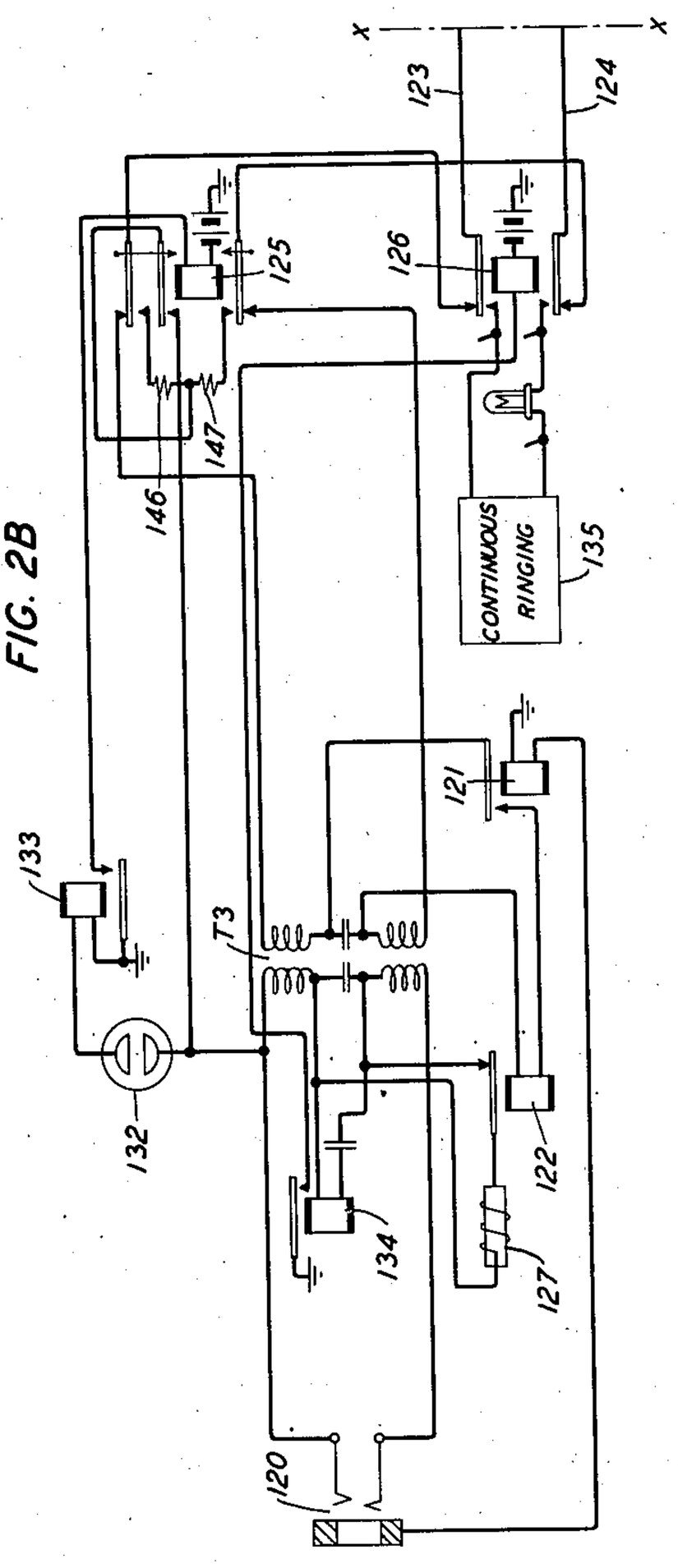


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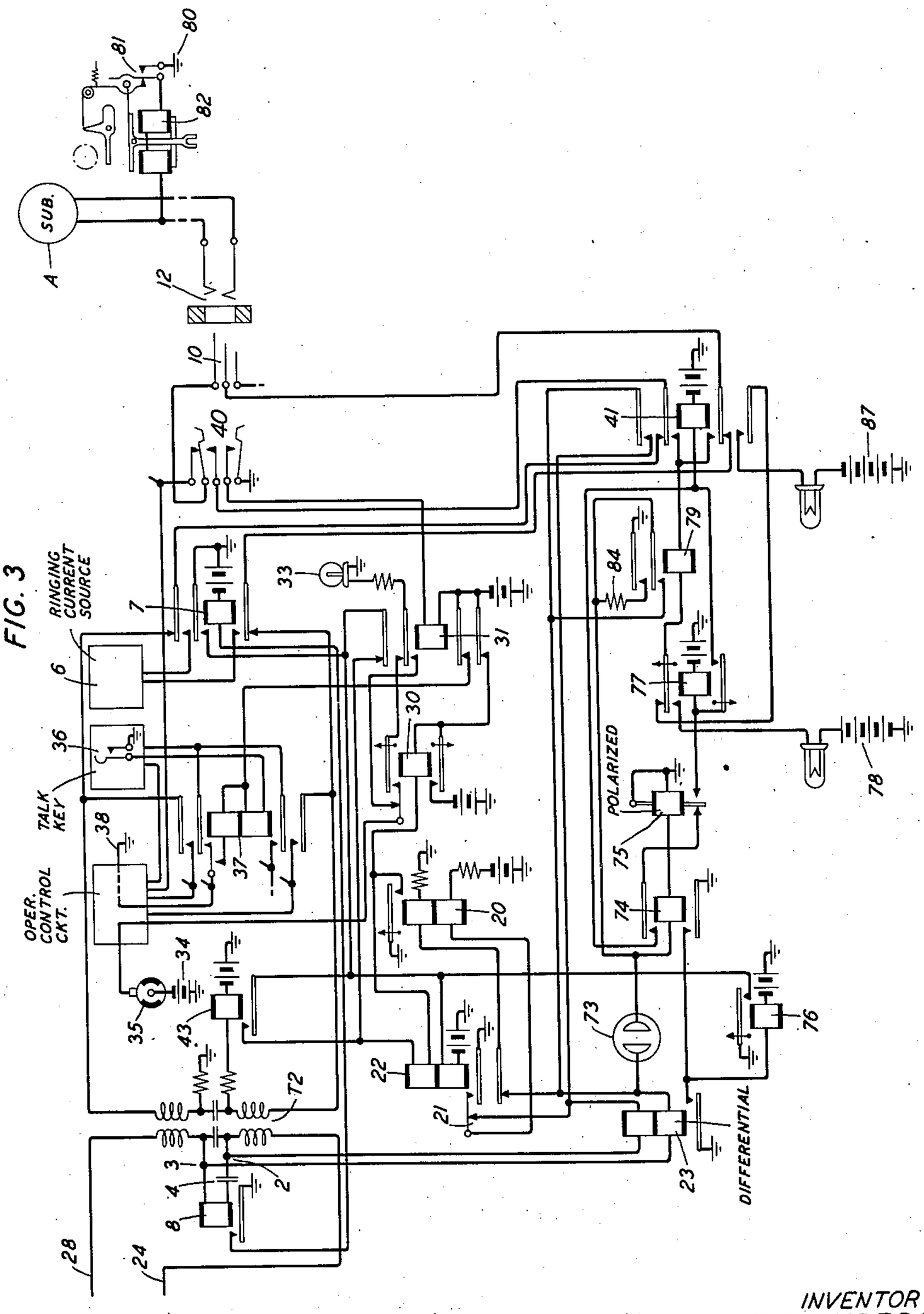
FIG. 3

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# UNITED STATES PATENT OFFICE

2,471,087

## TOLL OPERATOR CONTROL FOR TELEPHONE COIN COLLECTORS

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Application April 9, 1946, Serial No. 660,614

6 Claims. (Cl. 179—6.3)

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This invention relates to manual telephone systems and particularly to improved means for collecting and refunding coins deposited in the coin receptacle of a pay station in payment for toll calls originated at the station and completed through the combined services of a local exchange operator and an operator at a distant toll office.

In telephone systems of the general type described above, toll calls originating at a coin box station are extended to their ultimate destination through the combined services of local and toll operators. A calling subscriber at a coin box station originates a toll call in the usual manner, that is, by removing the receiver from its switchhook at the calling station and depositing a coin in the coin receptacle thereat. These operations result in the transmission of a call signal to the local exchange at which the calling line terminates. The "A" or answering operator at the local exchange answers the call in the well-known manner. Upon learning the nature of the call the local operator returns the deposited coin and connects the calling subscriber with the "long distance" operator who obtains, from the calling subscriber, the telephone number of the desired called line. The calling subscriber, in certain cases, is then requested to restore the receiver to its switchhook and is advised that he (or she) will be called when the connection is ready for completion. The details of the call are then passed to a toll operator at the office through which the connection is to be extended, who then understakes to complete a connection to the desired called line in well-known manner and when such connection is completed, she selects a toll switching trunk which extends from her position to the local exchange in which the calling line appears and over which the desired connection is to be completed. Seizure of this trunk by the toll operator at the distant office causes the display of a call signal which identifies the trunk at the local exchange. Usually the incoming end of this trunk appears before a "B" operator at the local exchange who, noting the actuated signal, connects her telephone set to the trunk and is requested by the toll operator to complete a connection from the trunk to the calling line. The toll switching trunk terminates at the local exchange in a plug with which the local operator tests the jack multiple of the calling line and, finding the line idle, inserts the plug into the jack multiple. Upon connection of the toll switching trunk to the calling line a supervisory signal at the toll

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operator's position is actuated which serves as a ringing signal to the toll operator. The toll operator then signals out over the toll switching trunk to cause the actuation of the signaling device at the calling station. When the calling subscriber responds to this signal he (or she) is requested to deposit the necessary toll, in coins, in the coin receptacle provided for this purpose. While the traffic just described may vary under certain conditions, it follows an accepted procedure.

Usually, the deposited coins are collected or refunded, as required, at the termination of conversation between the calling and called parties, assuming the time consumed on the connection does not exceed the prescribed initial period. Generally, these coin control operations are performed by the operator at the local exchange at the direction of the toll operator.

It is the object of the present invention to provide facilities, in a toll switching trunk, which enable the coin control operations, ordinarily performed by a local operator, to be performed by the toll operator at the distant exchange.

This object is attained, in accordance with a particular feature of the invention by the provision of a toll switching trunk which embodies a voltage responsive device, or vacuum tube, in each of the outgoing and incoming ends of the trunk, the former of which functions in response to the application of coin control battery to the tip conductor of the trunk by the toll operator to superimpose on the trunk a simplex circuit, and to extend the tip conductor of the outgoing end of the trunk thereto to cause the transmission of coin control current over the tip and ring conductors of the trunk, in parallel, to the incoming end of the trunk at the local exchange. The vacuum tube in the incoming end of the trunk responds to the transmitted coin control current and controls the connection of the corresponding coin control battery at the local exchange to the calling line to cause a corresponding coin control function to be performed by the coin magnet at the calling station. In this manner the operator at the local exchange is relieved of the duty of performing the necessary coin control operations and such operations are placed under the direct control of the toll operator at the distant toll board.

This and other features of the invention will be better understood from the following detailed description when read in connection with the ac-

companying drawings, in which:

Figure 1 is a circuit diagram of a toll cord circuit located at a distant toll office, together with certain portions of the position and coin control circuits which function with the toll cord. Only those portions of the cord, position, and coin control circuits which are essential to a complete understanding of the invention are illustrated in this figure;

Fig. 2A is a circuit diagram of the outgoing end of a toll switching trunk arranged for sleeve-type supervision and which embodies features of the invention;

Fig. 2B is a circuit diagram of the outgoing end of a toll switching trunk arranged for bridge-type supervision and which embodies features of the invention;

Fig. 3 is a circuit diagram of the incoming end of the toll switching trunk which functions with each of the circuits shown in Figs. 2A and 2B. This figure also shows schematically a subscriber's line extending to a coin-box station; and

Fig. 4 is a block diagram showing the manner in which the other figures of the drawings are to be assembled to effect operative systems.

In the following descriptions it will be assumed that a subscriber at station A has originated a toll call; that the answering operator at the local exchange has passed the necessary information to the toll operator at the distant toll office in the well-known manner and as outlined hereinbefore; and that the toll operator has completed the other end of the desired connection and proceeds to complete the originating end of the connection by the insertion of the toll cord front plug 90 into the jack 14 of the toll switching trunk extending to the local exchange.

When the toll operator has completed the other end of the connection to the called line she inserts the front plug 90 of the toll cord into jack 14 of the toll switching trunk whereupon a circuit is completed extending from grounded battery, winding of sleeve relay 91, upper winding of sleeve relay 92, normal make-before-break contacts of relay 93, sleeve contacts of plug 90 and jack 14, lower winding of relay 15, to ground. Relay 91 operates in this circuit but relay 92 being marginal does not operate owing to the high resistance of the sleeve circuit.

Relay 91 in operating completes an operating circuit for relay 94 to ground at the armature and back contact of relay 92. Relay 94 in operating locks to ground at its middle upper armature and front contact under the control of relay 91, thus remaining operated independent of the condition of marginal relay 92. At its two lower armatures relay 94 opens the ringing leads from the alternating current supply 95 to the ringing key 96 and connects the direct current source 97 to the tip spring of ringing key 96 by way of the outer lower armature and front contact of relay 94. At its outer upper armature relay 94 opens the circuit to relay 98 and at its innermost upper armature and front contact connects the winding of relay 93 in parallel with the upper secondary winding of relay 99.

In the outgoing end of the toll switching trunk relay 15 operates in the originally traced sleeve circuit and completes an obvious operating circuit for slow operating relay 16. Relay 16 operates slowly in this circuit and at its armature and front contact connects the winding of relay 17 to the line side of repeating coil T for receiving signals from the local station A and transmitting them to the sleeve circuit of the toll cord.



With relay 17 bridged across the trunk conductors 24 and 28, relay 20 in the incoming end of the toll switching trunk operates. The operating circuit for relay 20 may be traced from grounded battery, lower winding of relay 20, contacts 21 of relay 22, upper winding of relay 23, lower left winding of repeating coil T2, ring conductor 24 of the trunk, inner lower armature and back contact of relay 25, lower right winding of repeating coil T, lower armature and back contact of relay 26, front contact and armature of relay 16, winding of relay 17, back contact and upper armature of relay 26, upper right winding of repeating coil T, back contact and outer upper armature of relay 25, tip conductor 28 of the trunk, upper left winding of repeating coil T2, lower winding of relay 23, back contact and outer armature of relay 22, upper winding of relay 20, to ground. Relay 20, operated, completes an obvious operating circuit for relay 30 which finds battery at the outer lower armature and back contact of relay 31.

Relay 22 also operates under control of relay 20 in a circuit which is traced from grounded battery, lower winding of relay 22, outer upper armature and back contact of relay 31, upper winding of relay 22, to ground at the armature and front contact of relay 20. Relay 22, operated, disconnects battery and ground supplied through the windings of relay 20 from the ring and tip conductors of the toll switching trunk towards the distant toll board and connects the lower winding of relay 20 to direct ground at the inner armature and front contact of relay 22 thus holding relay 20 operated and releasing relay 17 at the distant end of the trunk. It will be understood that when relay 17 was first bridged across the trunk it operated together with relay 20 and, in operating, connected the upper winding of relay 15 in shunt with the lower winding thereof to decrease the resistance of the sleeve circuit in the toll cord TC. With this decrease in resistance marginal relay 92 operated and completed an obvious energizing circuit for the supervisory lamp 100 at the toll operator's position, in which circuit the lamp is lighted. When relay 17 releases, as described, the original sleeve condition is restored and relay 92 releases its armature causing the supervisory signal 100 to be extinguished.

When relay 30 operated as previously described it completed a locking circuit for itself by way of its lower armature and front contact, and at its upper armature and front contact it completes an intermittently energized circuit for the "guard and disconnect" lamp signal 33 at the local exchange. This circuit may be traced from grounded battery 34, interrupter 35, upper armature and front contact of relay 30, back contact and inner upper armature of relay 31, filament of lamp 33, to ground. The lamp 33 flashes in this circuit as a call signal at the local exchange.

The answering "B" operator at the local exchange upon noting the flashing lamp signal 33 associates her telephone set (not shown) with the trunk by the operation and release of the non-locking "talk" key 36, whereupon relay 37 operates in a circuit extending from grounded battery, inner lower armature and back contact of relay 31, lower winding of relay 37, to ground at contacts of key 36. Relay 37 locks to ground through its upper winding and all "talk" keys of the position when key 36 is released. The "talk" keys

of the position, other than key 36, have not been illustrated; the locking ground however is indicated at 38. Among the functions performed by relay 37 is the connection of the operator's telephone set (not shown) to the trunk for communication. Other functions performed by relay 37 need not be described since their description is not necessary to a complete understanding of the invention. The "B" local operator then ascertains from the toll operator the number of the line with which the plug 10 of the trunk is to be connected and having done so, touches the tip of plug 10 to the sleeve of jack 12 for test purposes in the well-known manner. Assuming the calling subscriber at station A had restored the receiver to its switch-hook after originating the call to the local "A" operator, the line would test idle and the local "B" operator would then insert plug 10 into the jack multiple 12 and cause the release of key 40. At its lower alternate contact key 40 completes an obvious operating circuit for relay 31 and at its upper alternate contacts extends the tip of plug 10 to the inner upper armature of relay 41.

Relay 31, operated, extinguishes the "guard and disconnect" lamp 33 and opens the holding circuit for relay 37 whereupon this relay releases and disconnects the operator's telephone set (not shown) from the trunk. Relay 31 also opens the circuit to relay 22 causing this relay to release and reconnect battery and ground to the trunk through the windings of relay 20. This causes relay 17 to operate and light lamp 100 as a ringing signal to the toll operator.

The tool operator now signals the calling station A by actuating key 96 associated with the front end of the toll cord TC. When this is done a circuit is completed from the 48-volt battery 97, front contact and outer lower armature of relay 94, upper alternate contact of key 96, tip contacts of plug 90 and jack 14, back contact and outer lower armature of relay 25, upper left winding of repeating coil T, upper winding of marginal relay 63 and parallelly connected resistance 64, back contact and armature of relay 62, winding of relay 26, retard coil 65, to ground at the armature and back contact of relay 62. Relay 63 does not operate at this time. Relay 26, however, operates and connects the ringing supply 9 to the line side of the repeating coil T and thence to trunk conductors 24 and 28 by way of the back contacts and the inner lower and outer upper armatures of relay 25, through the left windings of repeating coil T2, condenser 4 and the winding of relay 8. Relay 26 also disconnects the winding of relay 17 from the trunk causing the lamp 100 to be extinguished. Relay 8 responds to the current from source 9 and at its armature and front contact completes an obvious operating circuit for relay 7. Relay 7 operates and at its two outer armatures opens the tip and ring conductors towards repeating coil T2 and connects the ringing current source 6 to the tip and ring contacts of plug 10 by way of the back contacts and the upper and lower armatures of relay 41. At its inner upper armature and front contact relay 7 reoperates relay 22. The operation of relay 22 holds relay 20 operated through its lower winding. When ringing current is disconnected from the trunk at the distant tool position relay 8 releases, in turn releasing relay 7 which releases relay 22. Relay 7, released, disconnects ringing current from the station A. The release of relay 22 relights the toll operator's supervisory signal 100 in a manner previously described and under control of relay 17 which is reconnected to the trunk when relay 26 releases incident to the disconnection of battery 97.



It will be observed that when relay 22 operates as described above it disconnects relay 20 from the tip and rink conductors of the trunk thereby removing the low resistance which shunts vacuum tube 73 and relays 74 and 75. However, as vacuum tube 73, under the ringing condition, is connected to the grounded tip of the trunk the potential applied to the tube will be too low to break down the control gap of the tube.

When the receiver is removed from the switchhook at station A, relay 43 operates over the closed subscriber's line loop and completes an obvious operating circuit for relay 22. Relay 22, operated, locks relay 20 operated and extinguishes the toll operator's signal 100 by disconnecting battery and ground from the ring and tip conductors 24 and 28 of the trunk which results in the release of relay 17 and the consequent release of marginal relay 92 in the toll cord.

The toll operator then requests the subscriber at station A to deposit the prescribed tariff, for the desired call, in coins in the coin box at the substation.

Conversation between the calling party at station A and the called party may now take place, it being understood that the connection to the called line has been completed by the toll operator in any well-known manner.

It will now be assumed that the time has come at which it is necessary for the toll operator at the distant toll board to collect the coins deposited at the coin box subscriber's station A, and it will further be assumed that the receiver is still off the switchhook at the substation.

With the receiver off the switchhook at station A relays 43, 22, 20, 30 and 31 are operated. To collect the coins the toll operator first actuates key 101 and then operates the coin collect key 102 in the position circuit. When key 101 is operated to the "talk" position, it being understood that only those portions of the key which are essential to the present invention are illustrated in the drawing, relay 99 operates in a circuit extending from grounded battery, lower winding of relay 99, contacts 103 of key 101, to ground at the inner armature and back contact of relay 104. At its inner lower armature and front contact, relay 99 connects ground at contacts 105 of key 101 to battery and ground through the winding of slow operating relay 104 so that relay 104 operates and, at its upper armature and front contact completes a locking circuit for relay 99 which is completed before the original energizing circuit for relay 99 is opened. At its two outer armatures relay 99 splits the toll cord, and at its outer upper armature and front contact connects the tip contact of plug 90 to the coin control keys 102 and 106.

With the plug 90 of the toll cord plugged into jack 14 of the toll switching trunk relays 15 and 16 in the outgoing end of the trunk are operated, as described, as are also relays 91 and 94 in the toll cord TC. When key 101 is operated, relay 93 operates in a circuit extending from grounded battery, winding of relay 93, front contact and innermost upper armature of relay 94, front contact and inner upper armature of relay 99 to ground at the upper armature and front contact of relay 104 in the position circuit. At its upper armature and front contact relay 93 removes the relays 92 and 91 from the sleeve circuit of the cord and connects them, through the resistance

108 to ground at the armature and back contact of relay 109, the resistance 108 simulating the sleeve resistance of the outgoing end of the trunk. Relays 92, 91 and 94 accordingly are not disturbed by the operation of relay 93 as the changeover is effected by way of make-before-break contacts of relay 93. At its lower armature and front contact relay 93 connects the sleeve of the front cord to battery and ground through the windings of marginal relay 110 and of relay 111, the resistance of which relays simulates that of relays 92 and 91 which were originally connected to the sleeve of the front cord. The resistance 108 insures a circuit for the front cord relays 92 and 91 from the time the front sleeve is transferred until relay 111 operates which it does when relay 93 operates, as described. When relay 111 operates it causes relays 199 and 109 to operate. Relay 199 maintains ground on resistance 108 to hold the cord sleeve relays.

When coin collect key 102 is operated, 110-volt positive coin collect battery 112 is connected to the tip of the front cord over a circuit which includes the filament of resistance lamp 151, winding of relay 113, closed contacts of coin collect key 102, normally closed contacts of coin return key 106, front contact and outer upper armature of relay 99, back contact and inner upper armature of relay 98, upper normally closed contacts of key 96, tip contacts of plug 90 and jack 14 to the point 60, and thence to ground over two parallel paths, one including the vacuum tube or space discharge device 61 and the winding of relay 62, and the other including the upper left winding of repeating coil T, upper winding of marginal relay 63 and the associated parallelly connected resistance 64, winding of relay 26 and retard coil 65.

Under certain resistance conditions of relay 26 the retard coil 65 and condenser 66 may be omitted and have been shown as means for improving the performance of the circuit when the resistance of relay 26 is below a certain prescribed limit. Retard coil 65 increases the impedance of the tip circuit which tends to reduce acoustic disturbances when the coin control battery is connected to the tip of the circuit. The inductive reactance of the retard coil also produces a momentary increase of the effective potential applied to vacuum tube 61 when the coin control key is oprated. Condenser 66 lowers the breakdown impedance to ground of the vacuum tube circuit.

Similarly, marginal relay 63 and resistance 64 may be omitted being required only when the shunting effect of the circuit through relay 26 to ground prevents reliable operation of the vacuum tube 61 and relay 62. Relay 63 is marginal and will not operate over its primary winding in parallel with resistance 64 when 48-volt ringing current is applied to the tip of the trunk. When 110-volt positive or negative coin battery is applied to the tip of the trunk relay 63 operates over its primary winding in series with relay 26. Relay 63, operated, removes the short circuit from its secondary winding and short-circuits the winding of relay 26 which immediately releases if it has operated before the back contact of relay 63 is opened. Relay 63 holds over its high resistance secondary winding which is inserted into the circuit to ground over the tip of the trunk. Vacuum tube 61 and relays 62 and 25 will then function in the manner to be presently described.

The resistances of the circuits previously traced are so selected that when the 110-volt coin collect battery 112 is connected to the tip of the trunk



incident to the operation of coin collect key 102, the effective potential applied to the tube 61 is sufficiently high to break down the control gap of the tube. Current then flows across the control gap to cause the operation of relay 62.

Relay 62 operating, disconnects ground from the winding of relay 26 and operates relay 25 over an obvious circuit. Relay 25, operated, disconnects the tip and ring conductors of the trunk from repeating coil T; connects the series resistances 70 and 71 across the tip and ring conductors 23 and 24; disconnects the switchboard side of repeating coil T from the tip of the trunk; and connects the tip of the jack 14 to the midpoint of resistances 70 and 71. The coin control current from battery 112 will then flow through resistances 70 and 71 over the tip and ring conductors 23 and 24 of the trunk in parallel to the incoming end of the trunk (Fig. 3) at the distant local office.

The parallel paths for the coin collect current from battery 112 may be traced from the midpoint of resistances 70 and 71 as follows: resistance 70, tip conductor 23 of the trunk, upper left winding of repeating coil T2 to the point 3, and resistance 71, ring conductor 24 of the trunk, lower left winding of repeating coil T2, to the point 2. It will be observed that at this time the ring connection from point 2 is opened at the contacts 21 of relay 22 which relay, as previously indicated, is operated. The direct current path through relay 8 is blocked by the condenser 4. The path over the tip conductor just traced to the point 3 is connected to ground through the lower winding of relay 23, vacuum tube 73, and the windings of relay 74 and 75. Though relay 113 in the coin control circuit at the distant toll board is included in series with battery 112, the resistance of the circuit just traced and after the break down of tube 73, as will be described presently, is too high to permit this relay to operate so that the lamp signal 115 controlled thereby does not operate.

When 110-volt coin collect battery 112 is connected to the tip and ring conductors of the trunk, as described, the effective voltage applied to vacuum tube 73 over the tip of the trunk causes the control gap of the tube to break down and current flows across the gap to cause relays 74 and 75 to operate in series. Relay 74 is a neutral relay and operates on either positive or negative potentials, whereas relay 75 is polarized and will operate only on positive potentials.

When relays 74 and 75 operate, relay 74 operates relay 76 which closes an obvious holding circuit for relay 22, and relay 75 operates relay 77, which connects 110-volt positive coin collect battery 78 to the winding of relay 79 and, at its lower armature and front contact completes an operating circuit for relay 41.

At its two inner armatures and front contacts relay 41 connects the 110-volt battery 78 through relay 79 to the tip and ring contacts of the calling line by way of the corresponding contacts of plug 10 and jack 12. At its outer upper armature and front contact relay 41 connects the tip and ring conductors 23 and 24 of the trunk in parallel through the windings of relay 23. At its two inner armatures and back contacts relay 41 disconnects the tip and ring of the trunk circuit cord from repeating coil T2.

It will now be observed that, with the short-circuiting of vacuum tube 73 and the interconnection of the tip and ring conductors through the windings of relay 23 by the outer upper armature

and front contact of relay 41, the parallelly connected paths find ground through the series connected relays 74 and 75. As will be indicated presently the resistance of the path over which the coin collect current passes is controlled by coin supervisory relay 79 which operates if a coin is present for collection in the coin box at station A and does not operate in the absence of a coin. In the unoperated condition of relay 79 the resistance of the circuit is high and the relay 113 in the coin collect circuit does not operate.

Assuming the calling subscriber has deposited coins in the coin box at station A as directed by the toll operator, ground 80 through the coin contacts 81 and the windings of coin magnet 82 will be connected to the line at the station. Coin collect current from battery 78 causes magnet 82 to operate and collect the deposited coins in the well-known manner, and causes relay 79 to operate. Relay 79, operated, short-circuits vacuum tube 73 and connects resistance 84 to ground in parallel with the windings of relays 74 and 75. The vacuum tube 73 is short-circuited to prevent relays 74 and 75 from releasing when shunted by resistance 84. The coin control current from the battery 112 at the toll office through resistance 84 in parallel with relays 74 and 75 holds these relays operated and the circuit resistance is reduced thereby causing relay 113 in the coin control circuit to operate. Relay 113, at its armature and front contact completes an obvious operating circuit for lamp signal 115. Relay 23 also operates on this coin collect current and connects a holding ground to relay 76.

When the toll operator releases the coin collect key 102, relay 113 is deenergized and lamp signal 115 extinguished. The release of key 102 removes coin collect battery 112 from the trunk conductors causing relays 23, 74 and 75 to release. Relays 62 and 25 in the outgoing end of the trunk also restore their armatures when key 102 is restored.

Relays 23 and 74 releasing, open the circuit to relay 76 which relay releases after a slight delay. Relay 75, released, causes relays 41 and 77 to release. Relay 41 on releasing, disconnects negative coin control battery 87 from the back contact of relay 77; disconnects coin control battery from the coin box line; disconnects the ring conductor of the trunk from the vacuum tube circuit, and reconnects the trunk cord conductors to repeating coil T2. Relay 79 is also released.

The operator at the toll office can verify the disposal of the coins at the coin box station by operating the coin collect key 102 a second time. The circuit again functions as previously described. However, if the coins have been collected the coin magnet 82 will not be connected to ground at the coin box station and there will be no path for the coin control current to ground at station A. Therefore, relay 79 does not operate and the lamp signal at the toll office fails to light.

Supervision from the calling line is obtained when the key 101 in the toll cord TC is in its operated condition under control of the marginal relay 110 in the position circuit. It was hereinbefore described how relay 111 operated over the sleeve circuit of the cord and outgoing end of the trunk. Relay 110 though connected in series with relay 111 did not operate at that time. When the receiver is replaced on the switchhook at station A, relay 43 releases, causing the release of relay 22 which reconnects battery and ground to the ring and tip conductors 24 and 28 of the toll switching trunk through the windings of relay 23. Relay 17 in the outgoing end of the trunk



therefor operates and at its armature and front contact connects the upper winding of relay 15 in parallel with its lower winding thereby reducing the resistance of the sleeve circuit and causing relay 110 to operate. Relay 110 at its armature and front contact completes a circuit, which includes resistance 119 for the operation of marginal relay 92 which completes an obvious circuit for supervisory lamp 100.

When the plug 90 of the toll cord is removed from the outgoing trunk jack 14 at the distant end of the trunk, relay 20 in the incoming end of the trunk releases. The release of relay 20 releases relay 30. Relay 30, released, causes the flashing of the "guard and disconnect" lamp 33 as a disconnect signal. The plug 10 of the trunk cord is then removed from the multiple jack 12 of station A, and key 40 is reoperated which releases relay 31 causing the lamp 33 to be extinguished and restoring the circuit to normal.

Had the party at station A restored the receiver thereat to its switchhook at the termination of the call prior to the initiation of the coin collect operation by the toll operator, relays 43 and 22 would have released and relays 20, 30 and 31 would be operated. Relay 23 does not operate in series with relay 20 because the windings of relay 23 oppose each other under this condition. When 110-volt coin collect batery 112 is connected to the tip and ring conductors of the trunk at the distant toll office, relay 23 operates in series with relay 20. Relay 23 operates relay 76 which, in turn, operates relay 22. Relay 22 operating, disconnects relay 20 from the trunk and connects ground to the lower winding of relay 20 to hold this relay operated. When relay 20 is disconnected from the trunk the windings of relay 23 are opened causing relay 23 to release. Relay 76 being slow releasing holds until relay 74 operates, as previously described, and again closes the operating circuit for relay 76.

The operation of relay 22 removes the shunt from vacuum tube 73, thus increasing the voltage applied to the tube so that the control gap of the tube will break down. Current will then flow through the tube to operate relays 74 and 75. The circuit then functions in the manner previously described.

When the coin collect battery is disconnected from the trunk at the toll office the circuit functions as previously described. When relay 76 releases under this condition relay 22 is released, leaving only relays 20, 30 and 31 operated.

Fig. 2B differs from Fig. 2A in that the former illustrates the outgoing end of a toll switching trunk arranged for bridge supervision whereas the latter illustrates the outgoing end of a toll switching trunk arranged for sleeve supervision. The incoming end of the trunk shown in Fig. 3 functions with either of the outgoing ends shown in Figs. 2A and 2B.

When the toll operator at the distant toll office inserts plug 90 into jack 120 of the toll switching trunk, Fig. 2B, relay 121 operates through its low resistance winding over the sleeve circuit of the trunk and toll cord TC in the same manner as did relay 15 of the trunk of Fig. 2A. At its armature and front contact relay 121 connects relay 122 to the right windings, or the local side of repeating coil T3 across the tip and ring conductors 123 and 124 by way of the back contacts and outer upper and lower armatures of relay 125 and the back contacts and armatures of relay 126. The low resistance of the sleeve of the trunk allows relays 92 and 91 in the cord sleeve circuit to operate. Relays 92 and 91 operate ap-

proximately at the same time and therefore do not permit relay 94 sufficient time to operate. Relay 92 at its front contact supplies ground through the armature and back contact of relay 116 for lighting the supervisory lamp 100 and supplies ground through the back contact and outermost upper armature of relay 94 for operating relay 98 which cuts in the repeating coil T4 and supplies talking battery and ground to the trunk through the windings of relay 116 and the windings of the repeating coil T4. Relay 98 also closes a circuit from key 101 through the windings of relays 110 and 111 in the position circuit.

With relay 122 now connected across the outgoing end of the trunk by the operation of relay 121, the former relay is prepared to receive supervisory signals. In its unoperated condition relay 122 connects the retard coil 127 across the jack side of repeating coil T3 so that relay 116 operates to open the circuit to the cord supervisory lamp 100.

With relay 122 connected across the local side of repeating coil T3, relay 20 in the incoming end of the trunk operates and causes relays 22 and 30 to operate as previously described. Relay 22, operated, disconnects battery and ground supplied through the windings of relay 20 from the ring and tip of the trunk, and connects the lower winding of relay 20 to ground, holding relay 20 operated and extinguishing the supervisory lamp 100 at the toll operator's position by causing relay 122 to release and complete the operating circuit for relay 116.

Relay 30, operated, lights the "guard and disconnect" signal 33 from intermittent battery supplied from battery 34 by way of interrupter 35 causing the flashing of lamp 33.

The call at the local exchange indicated by the flashing of lamp 33 is answered in exactly the same manner as previously described, by the operation of key 36 which causes relay 37 to operate. The functions performed by relay 37 have been fully described hereinbefore. When advised by the toll operator to connect with the line of station A, the local operator touches the tip of plug 10 to the multiple jack 12 of the desired line to make the usual busy test. If the line is found idle the local operator inserts plug 10 into jack 12, it being understood that after the busy test is made, the test key 40 is caused to be released to extend the tip conductor of station A to the inner upper armature of relay 41 and to complete an obvious operating circuit for relay 31, which relay operates and extinguishes the lamp 33. Relay 31 also releases relays 37 and 22.

With relay 22 released, battery and ground are connected to the ring and tip of the trunk through the windings of relay 20 causing the operation of relay 122 in the outward end of the trunk. Relay 122 operated, opens the energizing circuit for relay 116 which relay releases its armature and thereby causes supervisory lamp 100 at the distant toll operator's position to be lighted as a ringing signal.

To signal out over the line on which station A is located the toll operator actuates key 96 and either the "W" or "J" party ringing keys 130 or 131. Key 96 extends the tip and ring conductors of the front cord to the contacts of the party line ringing keys by way of the two lower armatures and back contacts of relay 94, the ringing keys being connected to the ringing current source 95 in the well-known manner and as indicated in the drawing. With the "W" party ringing key 130 operated ground is connected to the



tip conductor of the trunk and the alternating current terminal to the ring conductor so that vacuum tube 132 is at ground potential and therefore will not function under this ringing condition. If the "J" party key 131 is employed, negative superimposed ringing will be connected to the tip conductor and ground to the ring conductor of the trunk. Under this condition the control gap of vacuum tube 132 will break down on the ringing current and relays 133 and 125 will operate. However, relay 134 will also operate, in turn operating relay 126, which disconnects the trunk conductors from relay 125 and connects the continuous ringing current source 135 to the trunk. Relay 125 is made slow to operate in order that the relay 126 may operate first under this condition.

Assuming the "W" party ringing key 130 is operated by the toll operator, relay 134 responds to the ringing current connected to the trunk thereby and causes relay 126 to operate and project ringing current from the source 135 out over the trunk conductors 123 and 124. Relay 8 in the incoming end of the trunk thereupon operates and causes relay 7 to operate over an obvious circuit. Relay 7, as previously described, reoperates relay 22 and connects the ringing current source 6 to the line of station A to cause the actuation of the ringer thereat. Relay 22 holds relay 20 operated.

When the toll operator releases the ringing key 96 at the distant toll position, relays 134 and 126 in the outgoing end of the trunk will release causing ringing current to be disconnected from the trunk conductors. Relay 8 in the incoming end of the trunk then releases causing the release of relays 7 and 22. Relay 7 disconnects ringing current from station A. The release of relay 22 reconnects battery and ground to the ring and tip conductors through the windings of relay 23 to cause the operation of relay 122 in the outgoing end of the trunk. Relay 122, operated, opens the operating circuit for relay 116 which relay thereupon releases, completing an obvious energizing circuit for supervisory lamp 100.

When the party at station A removes the receiver from its switchhook in response to the incoming signal, relay 43 operates over the closed line loop at station A and causes relay 22 to operate. Relay 22, operated, locks relay 20 operated and opens the ring and tip conductors of the trunk to battery and ground through the windings of relay 20. Relay 122 in the incoming end of the trunk thereupon releases and reestablishes the operating circuit for relay 116 in the toll cord. Relay 116 operates and extinguishes the supervisory lamp 100.

The toll operator then requests the calling party at station A to deposit the required amount of coins in the coin box and conversation between the calling and called parties may proceed.

When it becomes necessary to collect the coins deposited at station A, the toll operator actuates the key 101 in the toll cord TC and follows this by the operation of coin collect key 102. Relay 99 then operates in a circuit extending from grounded battery, lower winding of relay 99, contacts 103 of key 101, to ground by way of the inner armature and back contact of relay 104. At its inner lower armature and front contact, relay 99 connects ground at contacts 105 of key 101 to battery and ground through the winding of relay 104 so that relay 104 operates and, at its upper armature and front contact, completes a locking circuit for relay 99 which is completed before the

original energizing circuit for relay 99 is opened. At its two outer armatures relay 99 splits the toll cord and at its outer upper armature connects the coin control keys 106 and 102 to the upper back contact of relay 98. When coin collect key 102 is operated, ground by way of contacts 140 of key 102 and contacts 142 of key 101 is connected to the upper winding of relay 98 thereby shunting it and causing the relay to release. The release of relay 98 extends the said upper back contact thereof to the tip of plug 90, thence over the tip of jack 120, vacuum tube 132, to ground through the winding of relay 133. Thus with keys 101 and 102 operated the 110-volt coin collect battery 112 is connected to the vacuum tube 132 and this voltage causes the control gap of the tube to break down and current then flows across the control gap to ground through the winding of relay 133. Relay 133 operates on this current and, in turn, causes relay 125 to operate.

Relay 125, at its two outer armatures and back contacts disconnects repeating coil T3 from the trunk conductors 123 and 124 and at the two corresponding front contacts connects resistances 146 and 147 across these conductors. At its inner upper armature and front contact relay 125 connects the tip of jack 120 to the mid-point of resistances 146 and 147. Thus coin collect current from the battery 112 is projected over the trunk conductors 123 and 124 to the incoming end of the toll switching trunk to control the connection of coin collect battery 78 to the calling line in the manner previously described. The operation of the circuit of Fig. 3 in response to the application of coin control current thereto has been fully described hereinbefore and need not be repeated at this time. Suffice it to say that if contacts 81 are closed to ground through a deposited coin the trunk resistance is reduced by the operation of relay 79 to cause relay 113 in the coin control circuit at the distant exchange to operate and light the pilot lamp 115 and the coin magnet 82 to collect the deposited coins. If no coin is in position to be collected the contacts 81 are opened and relay 79 does not operate so that relay 113 fails to light lamp 115.

When the coin collect key 102 is restored to normal relays 133 and 125 release. If the key is operated a second time to verify the collection of the coin the circuit again functions as described. However, if the coin has been collected the pilot lamp 115 will not light.

In each of the preceding descriptions the collection only of coins has been considered. If the conditions called for the refunding of the coins, coin-return key 106 would be actuated in place of coin-collect key 102 to connect 110-volt negative coin-return battery 148 and relay 149 to the tip circuit. The operation of the circuits is the same in either case except that in the return of the coins only relay 74 operates while polarized relay 75 remains unoperated so that relay 77 cannot operate. The 110-volt negative coin-return battery 87 at the local exchange is connected to the calling line by way of the back contact and upper armature of relay 77, which relay, as just indicated, does not operate when the deposited coins are to be returned.

Supervision is obtained in the case of the trunk circuit of Fig. 2B under control of relay 122. Disconnection is effected in the well-known manner and description of the circuit operations resulting therefrom is believed unnecessary.

What is claimed is:

1. In a manual telephone system, a toll office, a local office, a line terminating at said local office, a pay station on said line including a coin receptacle having coin disposal means associated therewith, a toll switching trunk connecting said line with said toll office by way of said local office, sources of coin control current at said local office, similar sources of coin control current at said toll office, means at said toll office for connecting one of the said sources thereat to the tip conductor of said trunk, space discharge means responsive to the connection of the said one of said sources to the tip conductor of said trunk for projecting current from said source to said local office over the tip and ring conductors of said trunk, and space discharge means at the local office responsive to the projected current from the said one of said sources at said toll office for connecting a corresponding one of the sources at said local office to said line to effect a corresponding operation of the coin disposal means at said pay station.

2. In a manual telephone system, a toll office, a local office, a line terminating at said local office, a pay station on said line including a coin receptacle having coin disposal means associated therewith, a toll switching trunk connecting said line with said toll office by way of said local office, a source of coin control current at said local office, a source of coin control current at said toll office, means at said toll office for connecting the coin control current source thereat to one conductor of said trunk, a space discharge device in said trunk at said toll office responsive to the connection of the said source of coin control current to said one conductor of said trunk, means controlled by said space discharge device for connecting the two conductors of said trunk in parallel and simultaneously connecting the said source of coin control current thereto for projection thereover to said local office, and means including a space discharge device in said trunk at said local office responsive to the current projected over the conductors of said trunk for connecting the source of coin control current at said local office to said line to effect the operation of the coin disposal means at said pay station.

3. In a manual telephone system, a toll office, a local office, a line terminating at said local office, a pay station on said line including a coin receptacle having coin disposal means associated therewith, a toll switching trunk connecting said line with said toll office by way of said local office, a source of coin control current at said toll office, a source of coin control current at said local office, a relay at said local office, a signal at said toll office, means at said toll office for connecting the coin control current source thereat to said trunk, space discharge means responsive to the connection of said source to said trunk for causing current from said source to be transmitted over said trunk to said local office, means at the local office responsive to the current transmitted over said trunk for connecting the coin control current source at said local office in series with said relay to said line to effect the operation of the coin disposal means at said pay station, and means controlled by said relay for operating said signal.

4. In a manual telephone system, a local exchange, a pay station line terminating at said local exchange, a station on said line including means for receiving coins, coin collect and refund batteries at said local exchange, a distant toll office, coin collect and refund batteries at

said toll office, a toll switching trunk having a plug-ended incoming end in said local exchange and a jack-ended outgoing end in said toll office, means including the plug end of said trunk for completing a connection from said toll office to said line by way of said trunk, means at said local exchange for controlling the connection of the coin collect and refund batteries thereat to said line by way of the plug end of said trunk, said means including a space discharge device responsive to the connection of coin control battery in parallel to the conductors of said trunk at said toll office, means at said toll office for connecting either of the coin control batteries thereat to one of the conductors of said trunk by way of the jack end thereof, means including a space discharge device at said toll office responsive to the connection of either of the coin control batteries to the said one trunk conductor for connecting the same said coin control battery to both the conductors of said trunk in parallel to effect the response of the space discharge device at said local exchange, and the consequent operation of the coin receiving means at said station.

5. In a manual telephone system, a local exchange, a subscriber's line terminating in said exchange, a station of the pay station type on said line including means for receiving coins, coin control batteries at said exchange, a distant toll office, coin control batteries at said toll office, means including a toll switching trunk for completing a communication connection between said distant toll office and said subscriber's line by way of said local exchange, means including a vacuum tube in said trunk at said toll office responsive to the connection of one of said coin control batteries at said toll office to one of the conductors of said trunk for superimposing on the conductors of said trunk a simplex circuit and for simultaneously connecting the said one of said coin control batteries at the toll office to the midpoint of said simplex circuit to effect the transmission of coin control current over the conductors of said trunk in parallel, means including a vacuum tube at said local exchange responsive to the coin control current transmitted from said toll office over said trunk conductors, and means controlled thereby for connecting a corresponding coin control battery at said local exchange to said line to effect the operation of the coin receiving means at said station in a corresponding manner.



6. In the telephone system, a toll office, a local exchange, a toll switching trunk extending between said office and said exchange, a source of coin control current at said toll office, a source of signaling current at said toll office, means responsive to the connection of said source of coin control current to one conductor of said trunk for completing a coin control circuit over both conductors of said trunk in parallel to said local exchange, said means also being capable of operation in response to the application of current from said signaling current source to said trunk, and means responsive to the connection of said signaling current source to said trunk for rendering the response of said first means to the connection of said signaling current source ineffective to complete the said coin control circuit over the conductors of said trunk in parallel.

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