

July 2, 1940.

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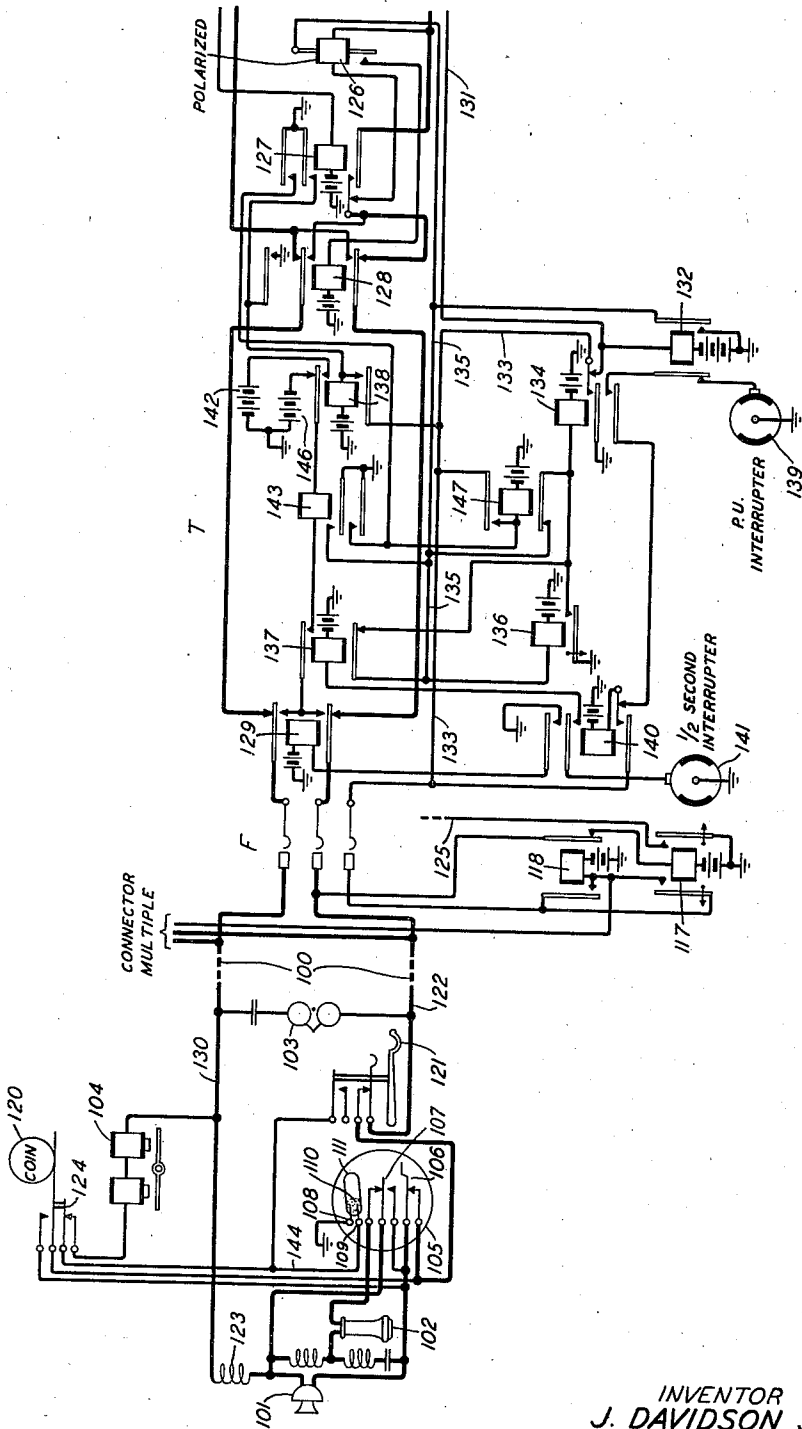
2,206,544

TELEPHONE SYSTEM

Filed July 19, 1939

2 Sheets-Sheet 1

FIG. 1



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2 Sheets-Sheet 2

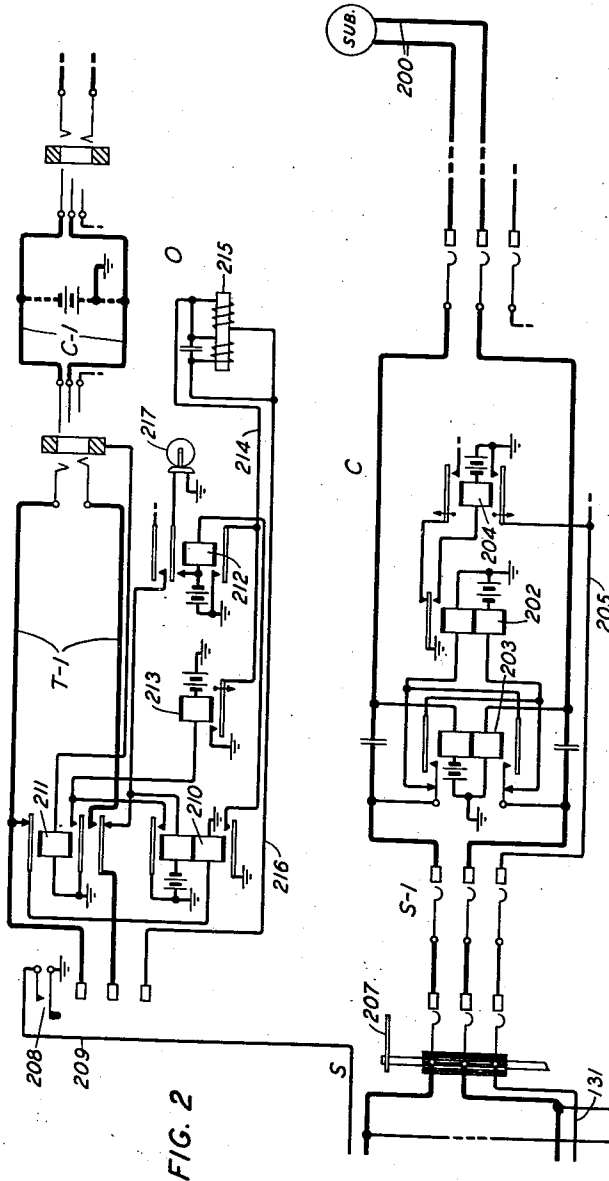


FIG. 2

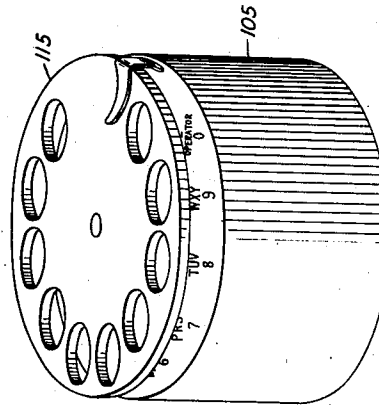


FIG. 4

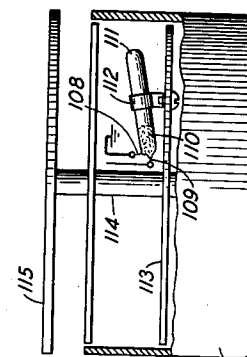


FIG. 3

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TELEPHONE SYSTEM

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8 Claims. (Cl. 179-6.3)

This invention relates to telephone systems and particularly to automatic and semiautomatic systems having coin controlled lines.

An object of the invention is to improve the dialing operation involved in establishing connections and to simplify the equipment by obviating the necessity of providing impulse repeaters.

Another object of the invention is to guard against the fraudulent operation of the coin disposal mechanism.

Another object of the invention is to simplify the mechanism necessary to distinguish between calls completed automatically and calls completed with the assistance of an operator.

It is the usual practice in coin controlled telephone systems to connect the coin line to ground at the substation in response to the deposit of the coin. Since the presence of this ground connection at the substation reduces to some extent the strength of the impulses transmitted by the substation dial, it has also been the usual practice to provide an impulse repeater in the central office for repeating the dialed impulses to the selector switches. These impulse repeaters require additional apparatus, and it has been proposed to dispense with them by providing off-normal contacts on the dial for disconnecting the coin ground from the line during the interval that impulses are being transmitted to the central office. However, the use of an off-normal contact on the dial for controlling the connection of the coin ground to the subscriber's line makes it possible for the patron at the coin station to interfere with the disposition of the deposited coin by the controlling circuits at the central office. For example, the calling patron, having deposited a coin and completed his conversation, might move the dial away from its normal position to open the coin ground and defeat the attempt of the equipment to collect the coin.

According to the present invention advantages over these prior arrangements are secured by means of a system in which the use of an impulse repeater is obviated without exposing the system to the liability of fraudulent interference on the part of the coin patron.

A feature of the invention whereby these advantages are secured is a coin controlled substation in which the impulse transmitting dial is equipped with a switch which is closed at all times the dial is at rest and which is opened automatically by centrifugal force at all times the dial is in motion. When closed this switch completes the ground connection through the coin controlled contacts and the coin disposal magnet,

and when opened this switch severs the ground connection. With this arrangement the coin ground at the substation is removed during the transmission of impulses from the dial and is connected to the line at all other times whether the dial is in its normal position or is held in some off-normal position by the patron. Any effort on his part, therefore, to defeat the collection of the coin by holding the dial off-normal after finishing his conversation would be unsuccessful. The switch for controlling the coin ground may comprise a small tube containing a globule of mercury which closes the circuit contacts when the dial is at rest and which is moved out of engagement with these contacts by the centrifugal force produced when the dial is rotating.

Another feature of the invention is a system in which the release of a connection, established fully by automatic switches under the control of the calling patron, depends upon a successful test for the presence of a coin ground at the end of conversation followed by the removal of said ground, and in which the operation of the selector switch under the control of the dial to extend the calling line to an operator's position results in the operation of means for canceling the requirements for said test in order that the connection may be released at the end of conversation whether or not there is a deposited coin to be disposed of at the calling station.

These and other features of the invention will be described in detail in the following specification and will also be set forth in the appended claims.

In the drawings accompanying the specification, Figs. 1 and 2 illustrate the circuit details of an automatic telephone system incorporating the features of the present invention.

Fig. 1 discloses a telephone line equipped with coin controlled mechanism and also shows a line-finder switch and a coin trunk circuit in the central office;

Fig. 2 illustrates, largely in diagrammatic manner, the selector and connector switches in the central office for extending connections to subscribers' lines and to operators' positions; and

Figs. 3 and 4 are views of an impulse transmitter suitable for use at the substation of the coin line shown in Fig. 1.

Referring particularly to the drawings, the pay station line 100 is equipped with the usual transmitter 101, receiver 102, ringer 103 and coin disposal magnet 104. The pay station is also equipped with an impulse dial 105 having the usual contacts 106 for transmitting impulses and

off-normal contacts 107 for opening the receiver circuit and for closing a short circuit around the transmitter 101. In addition to these contacts, the impulse transmitter is provided with a pair of contacts 108 and 109 which are opened and closed by a globule of mercury 110 contained within the tube 111.

The mercury switch associated with the impulse transmitter 105 is shown in greater detail in Fig. 3 of the drawings. This switch comprises a small tube 111 which is mounted by means of a suitable clamp 112 on a rotating part of the dial, such as the plate 113. Plate 113 is secured to the rotatable shaft 114 and rotates therewith in response to any manipulation of the finger-wheel 115. The tube 111 is mounted at an angle to the plate 113, as indicated in the drawings, so that the globule of mercury 110 remains in the end of the tube when the plate 113 is at rest. In this position of rest, the mercury globule 110 closes the circuit including the contacts 108 and 109. By selecting the angle at which the tube 111 is mounted with respect to the plane of rotation of the dial, it is possible to maintain a closure between contacts 108 and 109 at all times and in all positions of the dial, except when it is rotating at least as fast as its impulse sending speed. However, when the dial is rotating for the purpose of sending impulses to the central office, it produces enough centrifugal force to move the mercury globule out of contact with terminals 108 and 109.

The pay station line 100 appears at the central office in a line circuit, including the line relay 117 and the cut-off relay 118, and in the banks of line-finder switches such as the finder F.

The line finder F and the first selector switch S are interconnected by a coin trunk circuit T. The trunk T includes the necessary relays and other devices for controlling the disposition of the deposited coins and for controlling the establishment and release of the coins. It will be noted that the coin trunk T does not include the repeater generally required for repeating impulses from the dial at the pay station to the succeeding switches. Instead, the impulses sent by the calling patron are transmitted directly to the stepping magnets of the switches, and this is made possible by the mercury switch 111, which responds to the movement of the dial and disconnects the coin ground from the line so that it does not interfere with the transmission of the dial impulses.

The first selector S has access through certain of its contact levels to subscribers' lines by way of succeeding switches, such as the selector switch S-1 and the connector switch C. The first selector S also has access through a particular one of its levels, such as the tenth level, to operators' positions by way of operators' trunks, such as the trunk T-1.

While the invention is not limited to systems using any particular form of selector switch for establishing the connections, it has been illustrated herein in a system employing the well-known step-by-step type of switch. Also, the coin mechanism at the pay station may be of any suitable and well-known type.

The system will now be described in detail, assuming first that a patron at the pay station of the coin line 100 wishes to call the subscriber of a local line 200. To initiate the call a coin 120 is deposited in the box and the receiver 102 is removed from the switchhook 121. A circuit is then closed from battery through the winding

of the slow-release line relay 117, back contacts of cut-off relay 118, over the line conductor 122, closed switchhook contacts, contacts 106 of the dial 105, transmitter 101, coil 123, through the coin magnet 104, coin contacts 124, thence to ground through the closed contacts of the mercury switch 111. Relay 117 through its left contacts places a calling potential on the sleeve terminal of the finder F. At its right contacts the line relay 117 closes the start circuit 125, and the line finder hunts for the calling line.

The line finder F seizes the calling line in the well-known manner and extends it through to the first selector S. A circuit is now closed from battery through the right winding of the impulse relay 201, thence through the winding of polarized relay 126, normal contacts of relay 127 through the lower normal contacts of relays 128 and 129, through the middle brush of finder F, conductor 122, thence through the substation loop and returning over conductor 130 through the upper brush of finder F, upper back contacts of relays 129 and 128, through the left winding of relay 201 to ground. The direction of current flow in this circuit is such that the polarized relay 126 does not operate. Relay 201 operates and, in the well-known manner, causes the application of holding ground potential to the sleeve conductor 131. Ground on conductor 131 causes the operation of relay 132 in an obvious circuit. The cut-off relay 118 is also operated in a circuit from battery, through the winding thereof, left contacts of relay 117, thence over the sleeve brush of the line finder F, conductor 133, normal contacts of relay 134 to ground on conductor 131. Relay 118 locks through its own front contact to the grounded sleeve conductor and releases the line relay 117.

When relay 132 operates, it closes a circuit from ground through its right contacts, conductor 135, and thence in a parallel circuit through the winding of slow-release relay 136 to battery and lower back contacts of relay 147, winding of relay 134 to battery. Relay 136 operates and closes an obvious locking circuit for relay 134. Relay 134 at its make-before-break contacts disconnects sleeve conductor 131 from sleeve conductor 133 and closes a substitute circuit for maintaining ground potential on conductor 133. Relay 136 in operating closes a locking circuit for itself from battery, through the winding thereof, lower back contacts of relay 137 to ground at the contacts of relay 136. A second locking circuit of relay 136 is also closed from battery through the winding thereon, conductor 135, lower back contact of relay 147 to ground at the contact of relay 136.

The calling patron now manipulates the dial 105 to send impulses, causing the operation of relay 201 and the setting of the selector switch S. Thereupon the relay 201 is disconnected from the line, and the next series of impulses sets the succeeding selector switch S-1 to seize a trunk extending to an idle connector switch C. As soon as the connector C is seized a circuit is closed from battery through the lower winding of relay 202, lower normal contacts of relay 203, thence over the lower side of a connection through the trunk T and finder F and over the loop of the calling line as previously traced and returning over the other side of the connection through the upper normally closed contacts of relay 203, upper winding of relay 202 to ground. As before, the polarized supervisory relay 126 does not operate when current flows in this direc-

tion. Impulse relay 202 in the connector C operates the slow-release relay 204 which applies holding ground potential to the sleeve conductors 205 and 131. Finally, the calling patron transmits the last two series of impulses in the designation, and the connector switch C is operated to seize the called subscriber's line 200.

When the called subscriber answers, the usual circuit is closed for the operation of the supervisory relay 203, and this relay operates to reverse the direction of current flowing through the windings of relay 202 back over the extended connection, including the calling line. This reversal in the direction of current flow causes the operation of polarized supervisory relay 126, and a circuit is closed from battery through the winding of relay 128, contacts of relay 126 to the grounded conductor 135. Relay 128 closes an obvious operating circuit for relay 138, and the latter relay locks through its own contacts to the grounded conductor 133. The operated condition of relay 138 is an indication that the call has been established successfully and that the coin should be collected at the termination of conversation. Relay 128 also introduces a reversal in the tip and ring conductors of the coin trunk T. The purpose of this reversal is to restore control of the supervisory relay 202 in the connector switch to the switchhook contacts at the calling station so that the connector will be released when the calling patron replaces his receiver on the hook. Following the reversal by the relay 203, the lower winding of relay 202 is connected to the tip conductor 130 of the calling line, and this conductor is connected to ground through the coin contacts independently of the switchhook 121. Therefore, unless and until the coin is disposed of, the relay 202 in the connector switch may be held to prevent the release of the connection. This is avoided, however, as above explained, by introducing the second reversal in the tip and ring conductors by operating the relay 128.

When the subscribers have finished conversing, they replace their receivers on the switchhooks, and relays 202 and 203 release. After an interval, relay 204 releases and ground is removed from conductors 205 and 131, permitting the restoration of selectors S and S-1 and connector C. The removal of ground potential from conductor 131 causes the release of relay 132, but relay 136 remains operated as above explained. Relay 134 also remains operated and maintains ground potential on the sleeve conductor 133 to hold the line-finder switch F.

As soon after relay 132 releases as the rotating interrupter 139 advances to one of its conducting segments, a circuit is closed over the back contacts of relay 132, front contacts of relay 134, contacts and winding of relay 140 to battery. Relay 140 operates and locks through its own contacts to the grounded conductor 133. Relay 140 closes an obvious operating circuit for relay 129, and the latter relay disconnects the tip and ring conductors of the coin line from the corresponding conductors of the trunk T and connects them in simplex relation to the upper armature of relay 137. Following the operation of relay 140, the relay 137 is operated and released repeatedly under the control of the rotating interrupter 141, the circuit for relay 137 extending through the contacts of relay 140 to the interrupter 141. Each time the relay 137 operates it closes a circuit from the positive pole of the coin collect battery 142 through the front contacts of

relay 138, winding of relay 143, contacts of relay 137, through the front contacts of relay 129, over the conductors of the coin line, through the windings of the coin disposal magnet 104, closed contacts 124, conductor 144, through the contacts 108 and 109 of the mercury switch to ground. The polarized magnet 104 energizes in this circuit and operates its armature in the proper direction for collecting the deposited coin 120. If the magnet is not successful in collecting the coin in response to the first energization, the relay 137 continues to operate under the control of interrupter 141 to apply successive impulses of coin collect current to the line. It will be noted that the relay 137 at its lower contact opens one of the locking circuits of relay 136 each time the coin battery 142 is applied to the coin line. During the first of these intervals, however, the relay 136 is maintained energized over its other locking circuit, which extends through the lower back contact of relay 147. Also, during the first application of coin current to the calling line, relay 143 operates and closes a substitute holding circuit for relay 136. At the same time relay 143 operates relay 147 in an obvious circuit, and the latter relay locks through its upper front contact to the grounded conductor 133. On each succeeding application of coin potential to the line, relay 136 depends solely for its maintained operation on the circuit closed at the front contacts of relay 143. As soon as the coin is collected and the coin contacts 124 are opened the circuit for relay 143 is severed. Upon the next operation of relay 137 under control of interrupter 141 the holding circuit of relay 136 is opened and held open for an interval sufficient to permit the release of the latter relay. Relay 136 opens the holding circuit of relay 134 and the latter relay releases and removes ground potential from the sleeve conductor 133. The removal of ground from sleeve conductor 133 causes the restoration of the line finder F and the release of all associated relays.

It will be noted that the finder switch F is not permitted to release at the end of a call until the coin trunk determines, first, the presence of the coin ground at the calling pay station, and then the removal of said ground from the line. Since this coin ground is connected through the contacts 108 and 109 of the mercury switch 111 to the line when the dial is in any resting position and is disconnected from the line only while the dial is rotating, any attempt on the part of the patron to prevent the disposition of the coin by holding his dial off normal will be unsuccessful. By properly designing the mercury switch 111, the mercury globule 110 can be made to close the contacts 108 and 109 at all times except when the dial is rotating at a speed commensurate with the speed at which it restores to normal during the sending of impulses. At slower speeds and at the stopping points of the dial, the mercury globule immediately recloses the contacts and consequently the coin collect circuit.

If the call to the subscriber's line 200 is unsuccessful, that is, if the line is found busy or the called subscriber fails to answer, the supervisory relay 203 does not operate as above described and no reversal of current is effected to cause the operation of the polarized relay 126. And, since the polarized relay 126 does not operate, the charge relay 138 remains deenergized. When, thereafter, the calling patron replaces his receiver on the switchhook relays 202 and 204 release, and the selector and connector switches

restore as above described. The relay 137 is operated under the control of interrupter 141 as previously explained, but the negative pole of the coin refund battery 146 is now connected to the tip and ring conductors of the calling line. Consequently, the magnet 104 at the substation operates its armature in the proper direction for refunding the coin to the calling patron.

Assume next that the patron of the coin pay station wishes to make a call for which the services of the operator at position O are required. He initiates the call in the same manner, by depositing a coin in the box and removing his receiver from the switchhook. After the finder has found the line and extended it through to the first selector switch S, the calling patron manipulates his dial 105 to transmit a series of ten impulses. These impulses operate the selector switch S to the tenth level of terminals, and the switch hunts in this level and seizes an idle trunk T—1 extending to the operator's position. As the selector S reaches its tenth level position the cam 207 closes the level contacts 208, and these contacts remain closed until the switch is released from this level. Contacts 208 close a circuit over conductor 209, through the winding of relay 127 to battery. Relay 127 at its contact closes an operating circuit for relay 147, and the latter relay operates and locks to the grounded conductor 133. At its inner upper contact relay 127 closes an obvious operating circuit for the charge relay 138, and the latter relay locks through its lower contact to the grounded conductor 133.

When the selector S extends the connection through to the operator's trunk T—1, a circuit is completed from battery through the upper winding of relay 210, back contacts of relay 211, thence over the lower side of the connection, through the lower front contacts of relay 127, lower back contacts of relay 128, thence as above traced over the calling line and returning over the upper side of the connection through the inner upper back contacts of relay 128, through the upper brush of selector S, upper back contacts of relay 211 to ground through the lower winding of relay 210. Relay 210 operates relay 212 and slow-release relay 213 in obvious circuits. Relays 212 and 213 apply ground potential over conductor 214 through the right winding of coil 215, sleeve conductor 216, thence to sleeve conductor 131 to hold relay 132 operated. Relay 212 also lights the lamp 217 as a calling signal to the operator.

When the operator responds by inserting the plug of her cord circuit C—1 in the jack of the trunk T—1, the sleeve relay 211 is operated in the well-known manner, disconnecting the relay 210 from the tip and ring conductors of the trunk. Relay 211 at its inner lower contact closes a substitute holding circuit for relay 213 to maintain ground potential on the sleeve conductor 216. Relays 210 and 212 release and the lamp 217 is extinguished. The operator at position O converses with the calling patron and establishes the connection he desires. By means of the usual coin disposal circuits (not shown) the operator is able to refund the coin deposited at the pay station in the event no charge is necessary or to make any collections that may be required. Or, if the circumstances require it, the operator may request a deposit of the necessary coins for the connection she has established and permit the coin trunk T to collect these coins automatically at the end of conversation.

Assume that the operator succeeds in establishing the connection desired by the calling patron and that coins have been deposited in the box at her request in payment for the call. After the conversation is finished the calling patrons replaces his receiver 102 on the switchhook 121, and the operator is given the usual supervisory disconnect signal. When she withdraws the plug of her cord circuit from the jack of trunk T—1, relay 211 releases and releases slow-release relay 213. Relay 213 removes ground potential from the sleeve conductors 216 and 131 and relay 132 restores to normal. Relay 140 operates on the next closure of interrupter 139, causing the operation of relay 129 as above explained. On the next closure of interrupter 141, relay 137 operates and connects the tip and ring conductors of the calling line through the winding of relay 143 and the front contact of relay 138 to the coin collect battery 142. The coin magnet 104 operates to collect the coins, and, on the next operation of relay 137, relay 136 releases since relay 143 does not operate in this case and since relay 147 is already operated and locked as above explained. Relay 134 now releases, and the finder F and coin trunk T are restored to normal condition.

Assume that the operator collected the coins deposited at the pay station before the connection is released at the end of conversation. Under these conditions it is necessary for the coin trunk T to effect a release of the finder switch F without first testing for the coin ground and then for the absence thereof. It is possible for the trunk T to accomplish this result by reason of the fact that relay 147 was operated and locked at the time the selector switch S advanced to its tenth level position. On the first operation of relay 137 under the control of interrupter 141 at the end of the call the coin disposal circuit is closed through to the coin collect battery 142 as previously described. Since, however, the coins were previously collected by the operator, no ground potential exists at the substation, and relay 143 remains inert. Hence, relay 136 releases on the first operation of relay 137 since relay 147 is already operated and locked and relay 143 fails to operate. Relay 136 thereupon releases relay 134, and the finder switch is permitted to restore to normal, releasing the coin line for further use.

In this manner the coin trunk T is able to discriminate between a call to a subscriber's line and a call to the operator's position for the purpose of effecting the release of the coin line and line-finder switch, on a call to the operator, without requiring the presence of the coin ground at the pay station.

What is claimed is:

1. In a telephone system, a telephone line having a pay station thereon, automatic switches for extending said lines, an impulse dial at said pay station for operating said automatic switches, means responsive to the deposit of a coin at said station for establishing a ground connection to said line, and a set of normally closed contacts controlled by the movement of said dial and opened only while the dial is in motion for removing said ground connection from the line.

2. In a telephone system, a telephone line having a pay station thereon, automatic switches for extending said line, an impulse dial at said pay station for operating said automatic switches, means responsive to the deposit of a coin at said station for establishing a ground connection to

said line, and a switch operated by the rotating movement of said dial for opening said ground connection and for maintaining said connection closed at all times the dial is at rest.

5 3. In a telephone system, a telephone line having a pay station thereon, automatic switches for extending said line, an impulse dial at said pay station for operating said automatic switches, means responsive to the deposit of a coin at said station for establishing a ground connection to said line, and a switch operated by the centrifugal force produced by the rotation of said dial for opening said ground connection and for maintaining said connection closed whenever the dial is at rest.

10 4. In a telephone system, a telephone line having a pay station thereon, automatic switches for extending said line, an impulse dial at said pay station for operating said automatic switches, means responsive to the deposit of a coin at said station for establishing a ground connection to said line, a switch including a sealed tube attached to said dial, a globule of mercury in said tube movable by the centrifugal force produced by the rotation of said dial, and switching contacts closed by said globule to maintain said ground connection closed whenever the dial is at rest and opened by the movement of said globule while the dial is rotating.

15 5. In a telephone system, a telephone line having a pay station thereon, automatic switches for extending said line, an impulse dial at said station for operating said automatic switches, a coin receptacle and a coin disposal magnet at said pay station, a normally open connection from said line through said magnet to ground, contacts controlled by the deposit of a coin in said receptacle for closing said ground connection, means for applying current over a circuit including said line and said ground connection for operating said magnet to dispose of a deposited coin, and a switch having contacts controlled by said dial for closing said ground connection in any rotary position of the dial provided the dial is at rest and for opening said ground connection in response to the rotary movement of said dial.

20 6. In a telephone system, a calling line having a pay station thereon, an impulse dial at said pay station, means responsive to the deposit of a coin at said pay station for establishing a ground connection to said calling line, a central office in which said line appears, a called line, an operator's position, an automatic selector switch, other automatic switches, means in said central office for extending a connection from said calling line to said selector switch, means responsive to said dial for operating said selector switch to extend the calling line to said operator's position or to extend the calling line by way of said other automatic switches to said called line, means for

disposing of a coin deposited at said pay station after a call has been extended to said called line, means dependent on the presence of said ground connection and on the subsequent removal thereof for effecting the automatic release of said calling line, and means controlled by said selector switch when a connection is extended to said operator's position for rendering the automatic release of said calling line independent of the presence of said ground connection.

10 7. In a telephone system, a calling line having a pay station thereon, an impulse dial at said pay station, means responsive to the deposit of a coin at said pay station for establishing a ground connection to said calling line, a central office in which said line appears, a called line, an operator's position, an automatic selector switch, other automatic switches, means in said central office for extending a connection from said calling line to said selector switch, means responsive to said dial for operating said selector switch to extend the calling line to said operator's position or to extend the calling line by way of said other automatic switches to said called line, means responsive to the replacement of the receiver at the calling pay station for disposing of a coin deposited thereat, means responsive to the replacement of said receiver and dependent on the presence of said ground connection and on the subsequent removal thereof for effecting the automatic release of said calling line, and means dependent upon the position taken by said selector switch when a connection is extended to said operator's position for rendering the release of the calling line independent of the presence of said ground connection.

30 8. In a telephone system, a calling line having a pay station thereon, means responsive to the deposit of a coin at said pay station for establishing a ground connection to the conductors of said line, an impulse dial at said pay station, called subscribers' lines, an operator's position, a selector switch having terminals appearing in a plurality of groups, succeeding selector switches, a line finder for extending a connection from said calling line to said selector switch, means responsive to the operation of said dial for operating said selector switch to certain of said groups for extending the calling line to the called lines by way of said succeeding switches or for operating said selector to a particular group for extending said calling line to said operator's position, means dependent on the presence of said ground connection for effecting the release of said line finder, and circuit means rendered effective by said selector switch when operated to said particular group for rendering the release of said line finder independent of the presence of said ground connection.

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