A.E. CO. SEMI-POSTPAY COIN TELEPHONE SETS
DESCRIPTION

CONTENTS PAGE

1. GENERAL

1.01 This section describes the construction and operation of A.E. Co. semi-postpay coin telephone sets (see Figure 1). It is reissued with a change in title to include models from current production. Because of general revision, marginal arrows are omitted.

1.02 With few exceptions, the principles of operation apply generally to all semi-postpay instruments of A.E. Co. manufacture, dating back to the earliest sets marketed under the name "Autelco paystation". Illustrations in this section are of LPC-series models introduced in 1968, unless otherwise identified to show earlier construction.

1.03 Semi-postpay service is identified by the final significant digit 6 in the main body of the model number. The preceding digits or letters indicate the type of transmission components used, as follows:

60-series	Type 40 Monophone desk set components
90-series	F1A set components
LPA80-series	Type 80 (with series rheostat) components
LPB80-series	Type 80 (original varistor network) components
LPC -series	Type 80 (1967 revised network) components
LPA90-series	G1A set components

Models from current (LPC-series) production are available for dial service (LPC86) or for Touch Calling operation (LPC76). The absence of a suffix to the number indicates a set for nickel service. Suffix -55, available only on 90-series and later sets, indicates that the mechanism is arranged to accept two nickels or a dime. Suffix -10, available on all models except the current LPC-series, indicates that the mechanism will accept a dime only. The most common current model is the LPC86-55.

2. STATION OPERATION

2.01 Semi-postpay operation provides fully automatic enforcement of coin collection on local calls in central offices arranged for reverse battery answer supervision. The station user receives dial tone without deposit and is free to dial any number of digits required to place a local call or to reach the toll or EAS operator. Should his call for any reason not be completed, it is unnecessary for the instrument to return any coins, as none have been deposited. When the called party answers, the switching equipment reverses the polarity of battery feed to the calling line. This causes a polarized relay in the coin telephone set to short-circuit the transmitter and shunt the receiver, preventing conversation. If the station user deposits the proper amount, the passage of the coin through the mechanism permits some of the operated relay contacts to restore, removing the transmission impairments so the parties may converse.

2.02 After the coin station user restores the handset at the conclusion of the call, the polarized relay remains connected to the line. When sets built prior to 1963 are used on short loops, this combined loop and relay resistance may be low enough to hold the switchtrain. Instruments of current design have a diode in series with the relay which blocks reverse battery so the loop is effectively opened when the handset is restored. On these sets, as with those of the earlier design when used on longer loops, the switchtrain releases, and the station receives battery feed of normal polarity from the line circuit. If an older instrument is used on a short loop, the switchtrain is held until the called party disconnects, at which time the switching equipment returns battery feed to normal

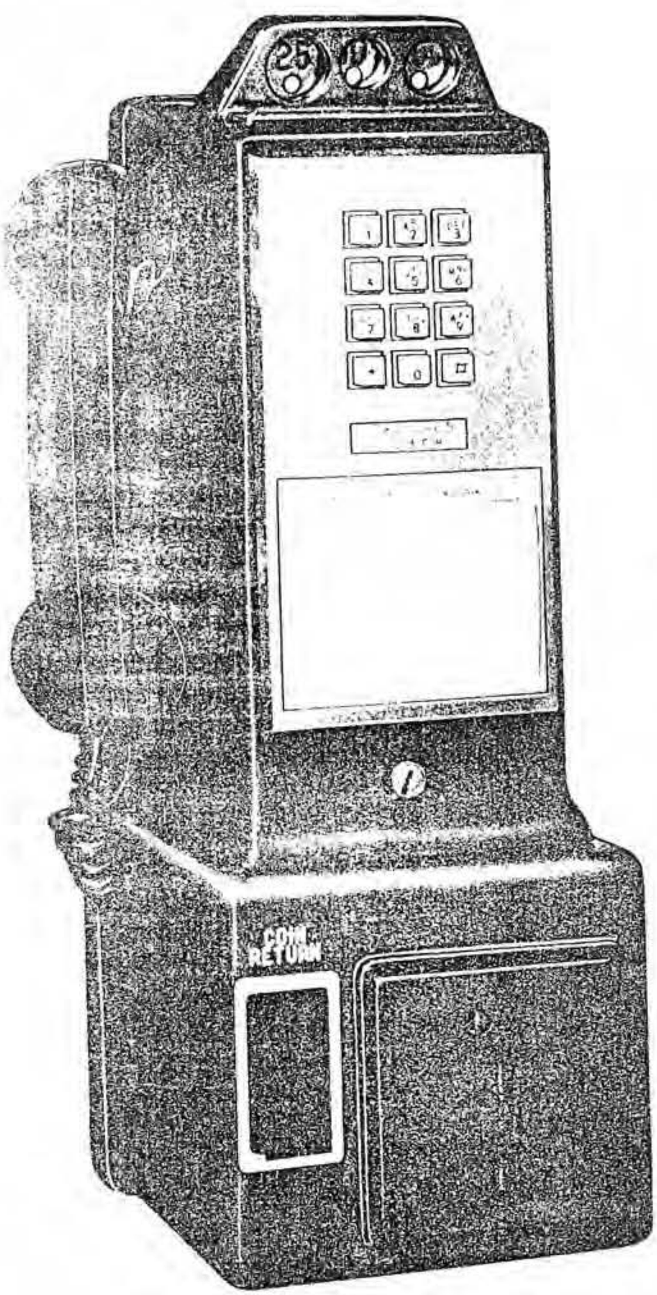


Figure 1a. LPC76-55 (Touch Calling).

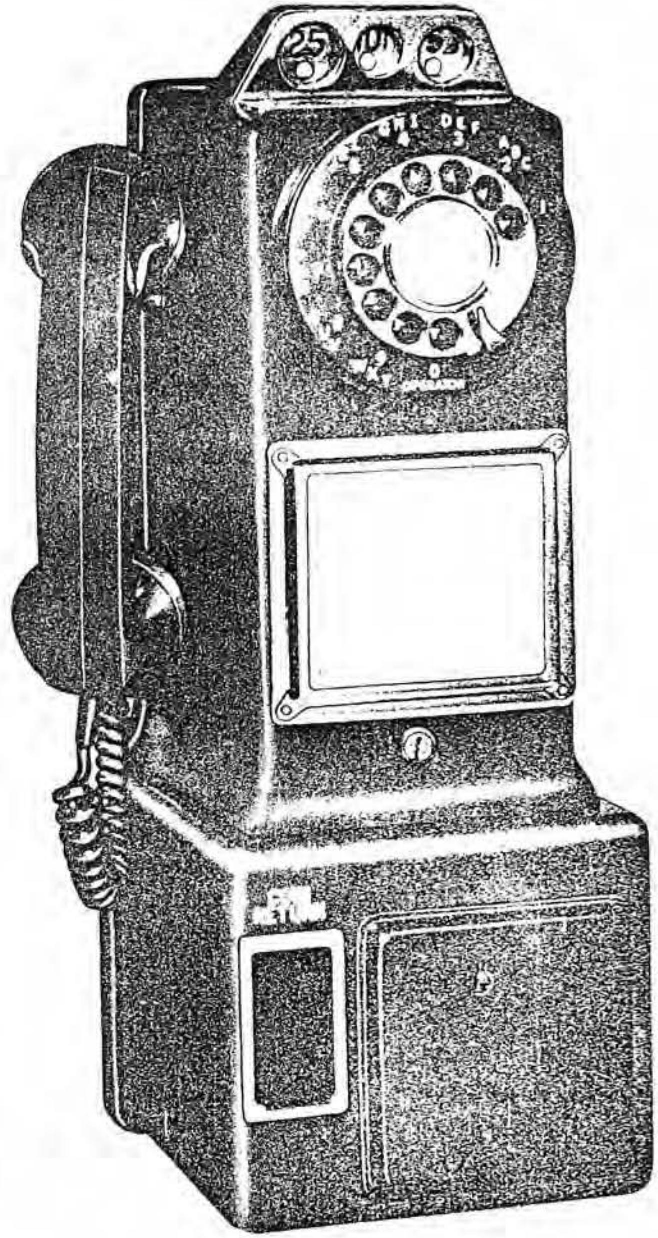


Figure 1b. LPC86-55 (Dial Service).

Figure 1. Semi-Postpay Coin Telephone Sets.

polarity on the calling line. As soon as normal battery is received, the polarized relay resets itself, disconnecting its coil from the line.

2.03 On calls to or through an operator's position, battery feed polarity on the coin service line remains normal, so the relay in the instrument does not operate when the operator answers, and no coin deposit is necessary to pass call details or make an inquiry. If the operator completes a connection for which a charge is due, she provides aural supervision of the coin collection before permitting conversation to proceed. Each coin deposited strikes either a cupped bronze or flat wire gong during its travel through the telephone set, and the tones so produced are picked up by a signal transmitter adjacent to the gong mountings and coupled to the line to provide an indication to the operator of the amount deposited.

3. COIN MECHANISM

Coin Gauge

3.01 The coin gauge at the top of the upper housing has three different size openings. Each of these openings is directly above the corresponding channel in the coin chute.

Coin Chute

3.02 The coin chute is mounted inside the upper housing directly below the coin gauge (see Figure 2). The three channels are designed so that only a coin of proper dimensions in the correct channel will operate the mechanism. All three channels end directly over the mouth of the coin hopper (see Figure 3). The lugs which hold the coin chute to the upper housing are part of a framework welded to the upper housing, which constitutes the coin return chute. Rejected coins fall down this chute to the coin return slot in the lower housing.

3.03 The three channels of the coin chute are arranged so that coins are directed to either a cupped bronze gong ("bell") or helical

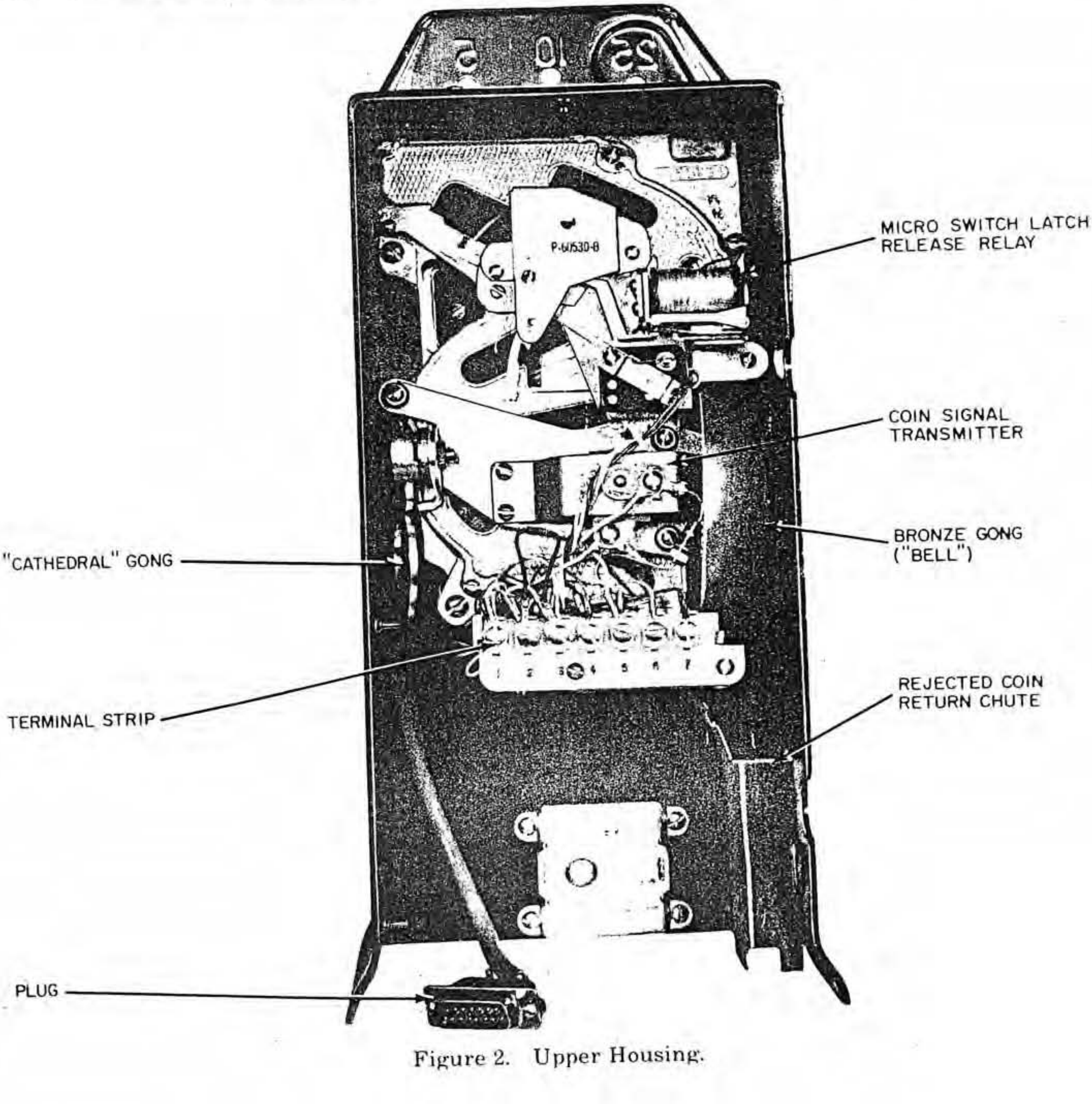


Figure 2. Upper Housing.

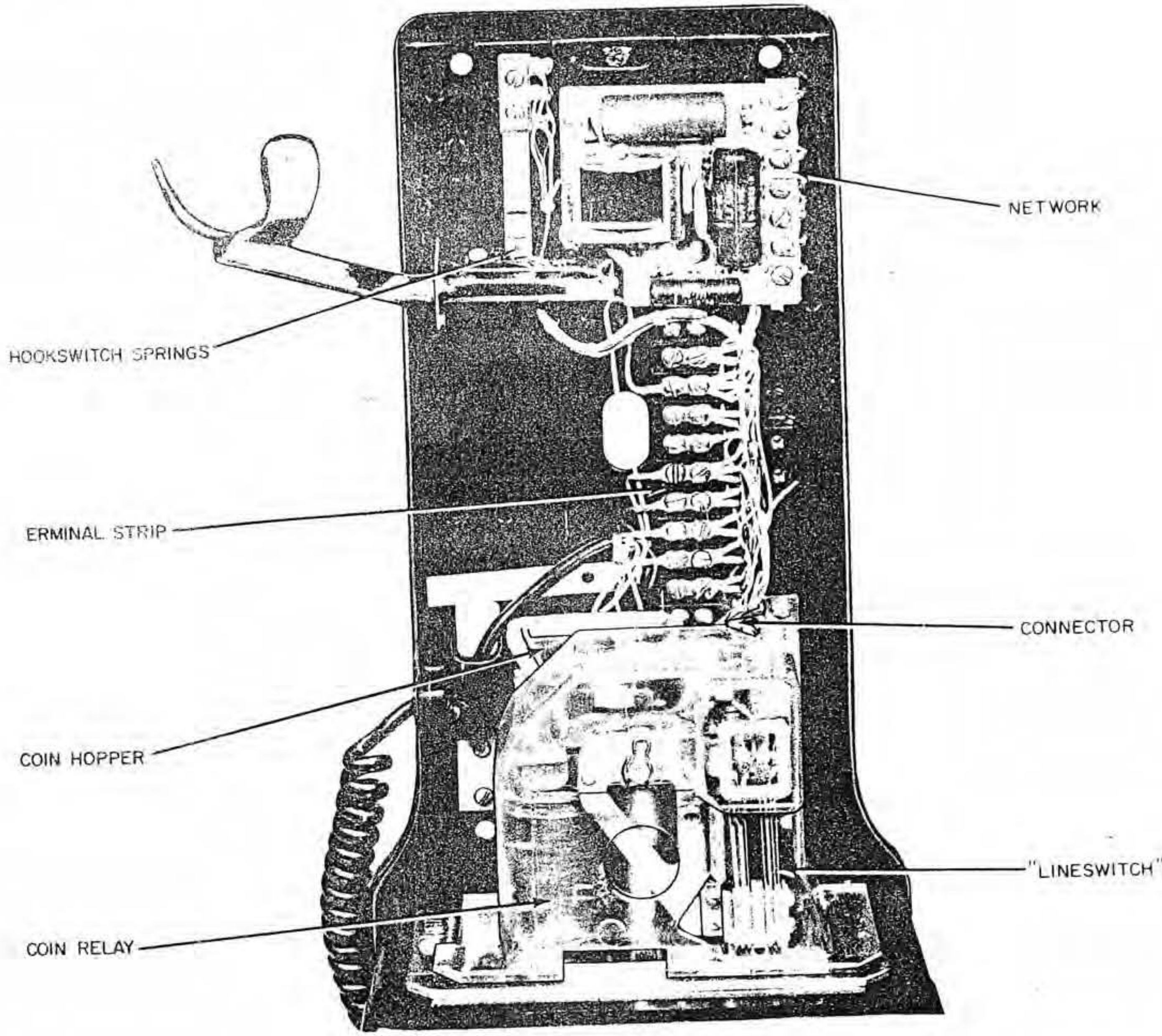


Figure 3. Lower Housing.

flat wire gong ("cathedral gong"). A nickel strikes once at the lower edge of the "bell", a dime strikes once at the upper edge and again at the lower edge of the "bell", and a quarter strikes the cathedral gong once. These gong signals are conveyed to the central office via the special transmitter mounted on the back of the coin chute (see Figures 2 and 4). In sets built since 1960 a permanent magnet mounted adjacent to the quarter channel on the coin chute acts as a slug rejector. A ferrous slug deposited in the quarter gauge will be attracted by the slug rejector and diverted to the cash compartment without striking the cathedral gong. It is thus confiscated to prevent further misuse, but is not accepted by the toll operator in the absence of any gong signal.

Coin Relay

3.04 Figures 5, 6 and 7 show the polarized coin relay in its normal condition. Two coils are mounted vertically on the base; on most sets, one coil is arranged with 2900Ω and 77Ω windings, and the other with a single 83Ω winding. The 77Ω and 83Ω windings are connected in series aiding, though on separate coils. The armature has a permanent magnet attached to its under side and is pivoted in the center above the two coils. Attached to its right end are two pair of roller-type buffers which engage the relay contact assembly ("lineswitch") when the armature is tilted to the right. One pair of these buffers is suspended from the armature on a swinging arm, while the other pair is fixed below the end of the armature. Suspended between the two sets is a switch lever, which pivots on the relay frame and extends its stop arm to the left, with the end stud positioned above the coin trigger by about ten mils. This permits the trigger to be tripped on coin deposits for toll charges, when the armature is normal, and to restore to its rest position after the passage of each coin.

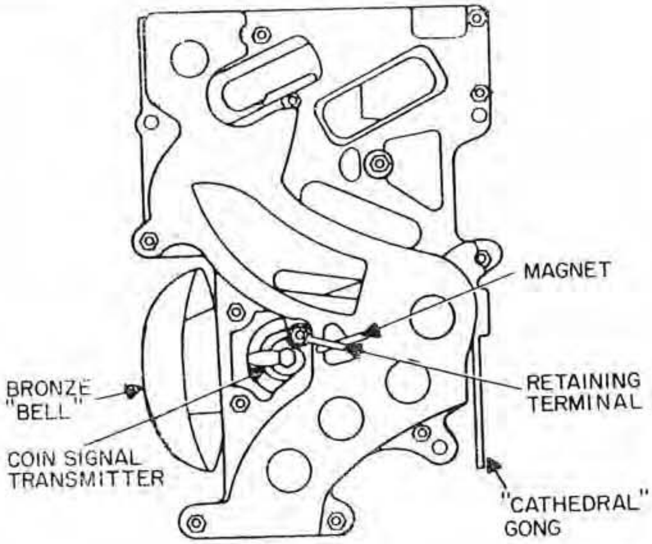


Figure 4. Coin Chute.

Coin Relay Operation

3.05 Figure 7 is drawn to show the coin relay in its normal condition, as found during dialing, waiting for the called party to answer, and throughout operator-handled calls. Note that the armature is tilted to the left, the coin trigger is at rest, and all "lineswitch" contacts are open. This situation applies when line polarity is normal (L1 negative). Under these conditions, current flows from L2 through the coin signal transmitter, dial pulse springs, handset transmitter, 12Ω resistor, induction coil primary winding, 78Ω coil of the "restoring" relay, 83Ω and 77Ω windings of the coin relay to the hookswitch contacts and L1, as shown in Figure 8. The "restoring" relay is the latch release relay provided on two-nickel models (see

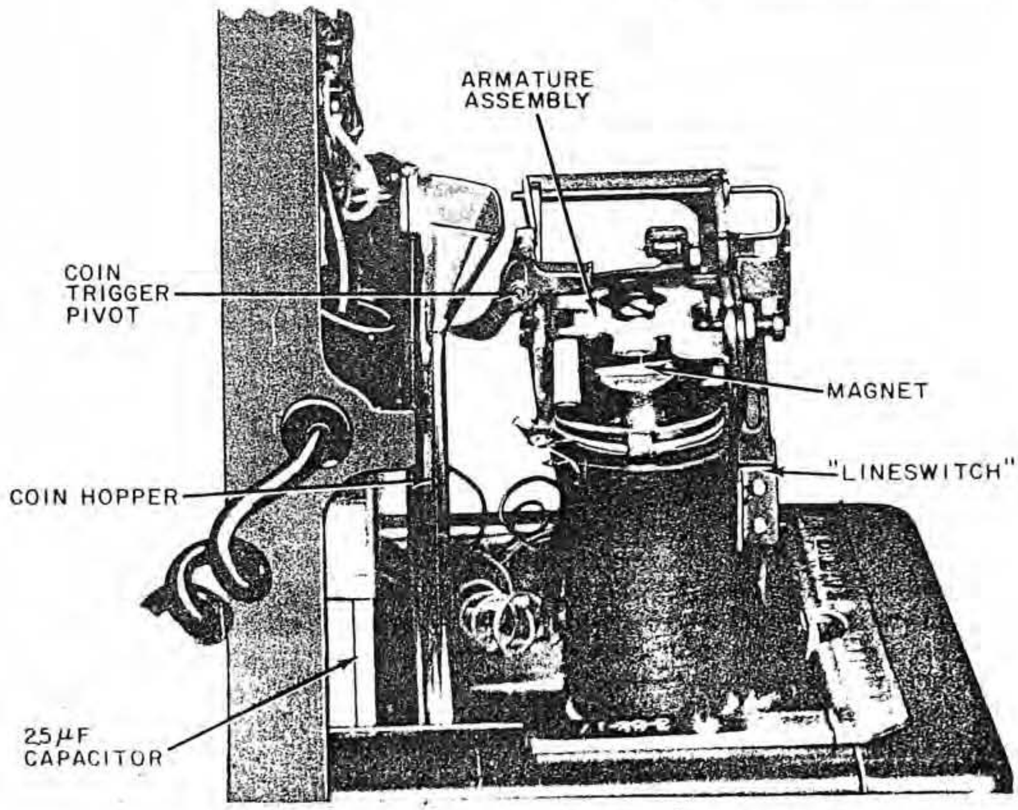
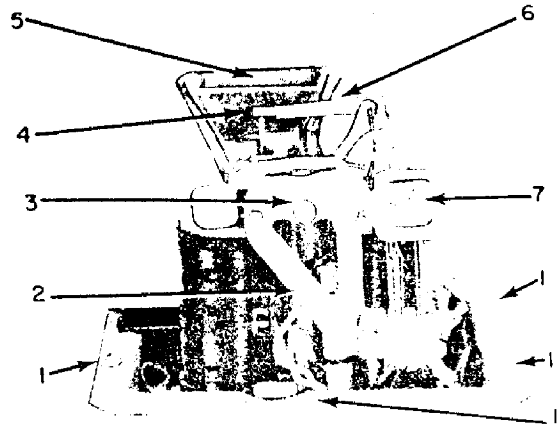


Figure 5. Coin Relay Installed in Lower Housing.

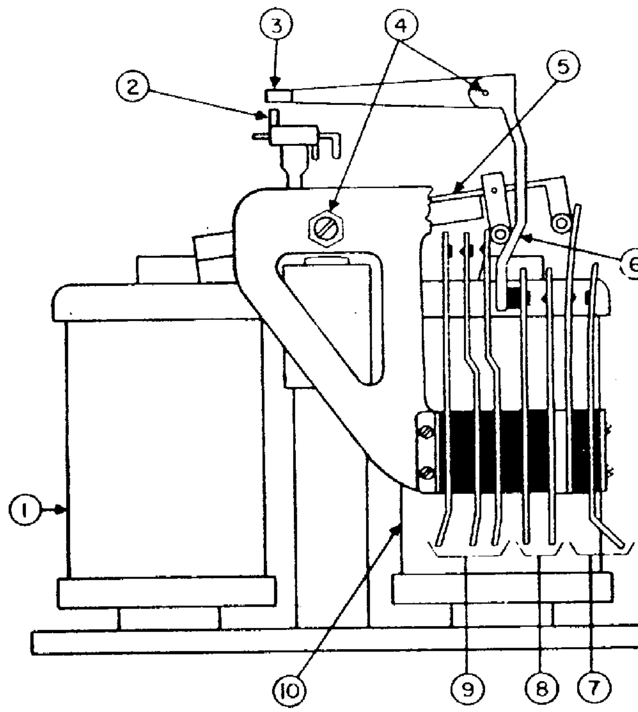
Paragraph 3.12); on earlier sets with the dime-only option, the same relay performs a different mechanical function to admit nickels to the nickel channel when battery is normal. The polarity of the armature magnet is such as to be repelled by the flux in the 83Ω winding. To prevent this flux on short loops from neutralizing the effect of the magnet and attracting the iron armature to the right, the 77Ω winding on the left hand coil provides a smaller flux to attract the armature magnet and keep it tilted to the left. Early 60- and 90-series sets used a relay assembly which lacked this winding and provided only a 3000Ω coil at the left and a 90Ω coil at the right. With this design it was necessary to provide a means of reducing or eliminating the flux generated by the 90Ω coil on normal battery. At first this was accomplished by providing a 90Ω resistance to be wired in parallel with the coil on short loop installations, and later by shunting the coil with a parallel rectifier.

3.06 When the called party answers on a local call placed from the coin service line, battery polarity on the line is reversed, so that current through the coin relay windings flows in the opposite direction. The flux generated by the 77Ω winding now repels the left end of the magnetic armature, while that in the 83Ω winding attracts the right end, which moves downward to the position shown in Figure 9. Roller-buffer 3, nearer the observer, operates "restoring" springs 6 and 7, which do no restoring, but connect the 2900Ω winding of the coin relay to the line (on most models it is short-circuited by a hookswitch contact). As roller 4, nearer the armature on the same shaft as 3, moves down, it permits the right edge of the switch lever to move farther to the right. This allows the left end of the stop arm to drop until it strikes the coin trigger stop surface. Roller 2, nearer the armature on the swinging arm, moves downward along the left edge of the switch lever and forces the swinging arm to the left. Roller-buffer 1, nearer the observer on the same shaft as 2, operates coin/shunt springs 1, 2 and 3, which short-circuit the transmitters and place a low-resistance shunt across the primary winding of the induction coil. Although the station user can faintly hear the called party answer, the efficiency of the receiver is reduced to an extent that renders it incapable of being used as a transmitter. On models for ten cent service, the 78Ω relay, which had been operated on normal battery, now releases as current flows instead through its parallel diode.



1. MECHANISM BASE MOUNTING SCREWS
2. FRAME ASSEMBLY
3. ARMATURE PIVOT SCREW
4. STOP ARM STUD
5. COIN HOPPER MOUTH
6. SWITCH LEVER
7. ARMATURE ROLLER BUFFERS (TWO PAIR)

Figure 6. Coin Relay (Front View).



1. 2900Ω/77Ω COIL
2. COIN TRIGGER
3. STOP ARM STUD
4. PIVOT POINTS
5. ARMATURE
6. SWITCH LEVER
7. "RESTORING" SPRINGS 6 & 7
8. "SHORT" SPRINGS 4 & 5
9. COIN/SHUNT SPRINGS 1, 2 & 3
10. 83Ω COIL

Figure 7. Coin Relay - Normal.

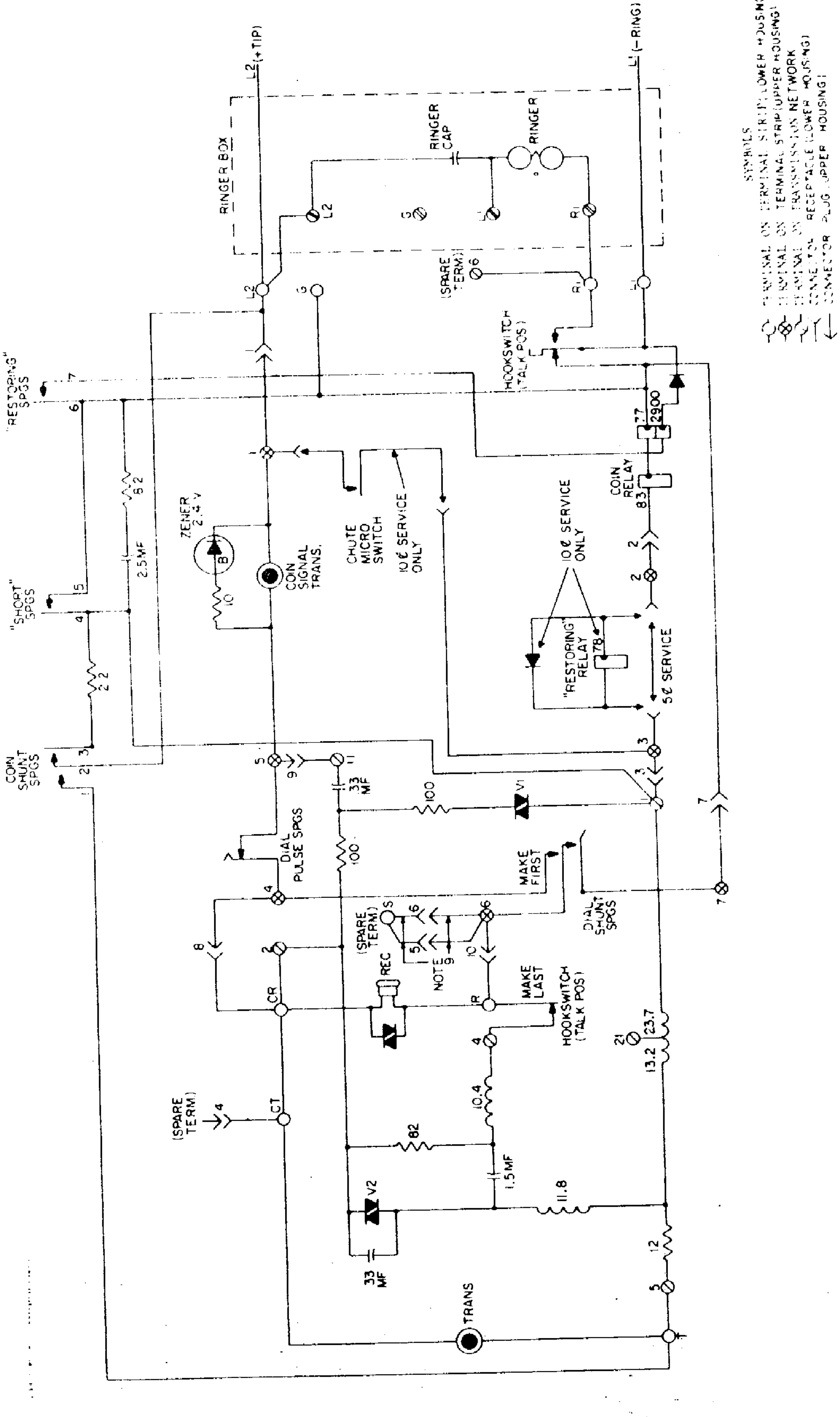


Figure 8. Schematic Diagram, LPC-Series Semi-Postpay Coin Telephone Set.

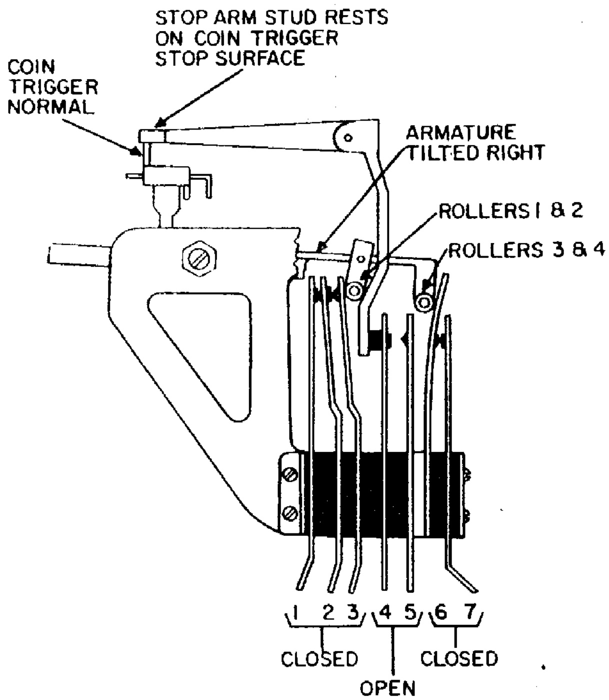


Figure 9. Coin Relay - Battery Reversed as Local Call is Answered.

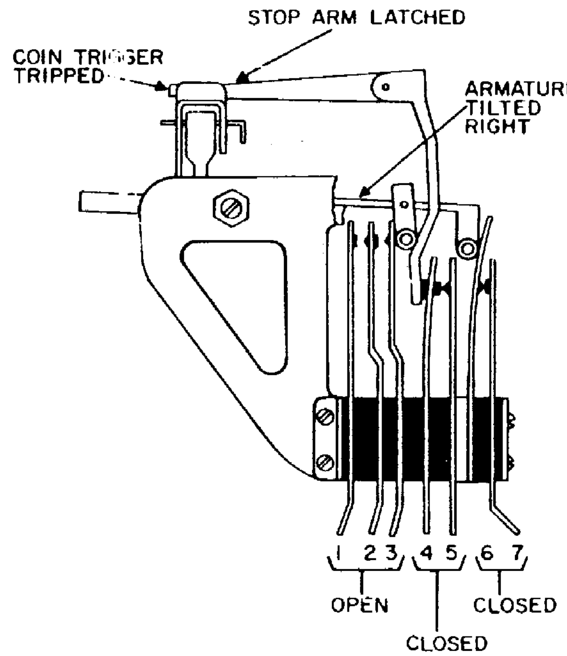


Figure 10. Coin Relay - After Deposit on Local Call.

3.07 If the station user deposits a coin to permit conversation, its passage through the upper housing of ten cent models causes the actions described in Paragraphs 3.11 and 3.13. As the first coin enters the hopper it trips the coin trigger, which no longer supports the stud of the stop arm. The restoring force of coin/shunt springs 1, 2 and 3 against roller-buffer 1 is transmitted by roller 2 to the switch lever, moving it to the right as the stop arm drops. This movement is sufficient not only to allow springs 1, 2 and 3 to open and remove the transmission impairments, but also to operate "short" springs 4 and 5 from a fixed buffer on the lower end of the switch lever, as shown in Figure 10. These springs short-circuit the 77Ω and 83Ω windings of the coin relay (and in ten cent models, the 78Ω winding of the relay in the upper housing) to remove their impedance from the transmission path. The latter now extends from L1 through the hookswitch contacts, "short" springs 5 and 4, the induction coil primary winding, 12Ω resistor, handset transmitter, dial pulse springs and coin signal transmitter to L2. The coin relay remains in this condition during conversation.

3.08 If the coin station user restores the handset first at the end of the call, the hookswitch contacts remove the short circuit from the 2900Ω winding of the coin relay, so that it is inserted in series with the line. If the called station handset remains off-hook, battery is still reversed as these contacts open. On LPC- and late LPB-series sets, a diode in series with the 2900Ω winding blocks current flow, so the loop is effectively opened and the switchtrain releases. On sets without the series diode, the switchtrain is held over the loop including the relay winding, unless the resistance of the station loop from office to instrument is rather high. When so held, the switching equipment keeps the 2900Ω winding energized until the called party disconnects, but the flux so generated is such as to repel the left end of the coin relay armature, which remains tilted to the right.

3.09 When the switchtrain is released, reverse battery is disconnected from the coin service line, which then receives battery feed of normal polarity from its line circuit. If the switchtrain has been held but the called party disconnects, battery feed to the calling line reverts to normal. The same applies if the called party disconnects first, and the coin station user then restores the handset. In any case, normal battery applied to the 2900Ω winding of the coin relay causes it to attract the left end of the armature, which moves downward. As roller 4 is moved upward at the right end, it bears against the right end of the switch lever and moves it to the left. This permits springs 4 and 5 to open, removing the shunt from the other relay coils so all are energized in series for an instant. Because of the series inductance of the 2900Ω winding, these contacts are protected from erosion by an RC spark suppression network consisting of an 8.2Ω resistor and 2.5μF capacitor. Movement of the switch lever also raises the stud on the left end of the stop arm high enough to clear the coin trigger and permit it to restore. At the same time, roller-buffer 3 moves upward and permits "restoring" springs 6 and 7 to open. Although this disconnects the 2900Ω winding of the relay coil, its core is fitted with a copper sleeve to retard decay of the flux so that enough remains to carry the armature the rest of the way to its normal position. With all contacts open, the coin telephone set is disconnected from the line and ready for another call.

Dime-Only Control

3.10 When ten-cent service was first introduced, it was feared that delay incident to the insertion of two nickels after the called party answers would be excessive, and lead to lost calls occasioned by the called party becoming impatient and disconnecting before deposit. To avoid this problem, it was decided to provide ten cent service on a dime-only basis by providing a coin chute which would accept nickels only in payment of toll charges. Such a chute is shown in the upper housing of Figure 11, and is fitted with a modified relay referred to as a nickel "rejector" but which acts to admit nickels when energized. This device, herein called the nickel admitter, is actuated by a class S relay which has no contacts and only a single restoring spring. An extension arm welded to its armature terminates in a notched end which engages a pivoted wire loop mounted adjacent to an opening in the nickel channel. With the relay armature normal, the loop lies in and across the channel, so that a nickel inserted into the coin gauge falls only a short distance into the chute before striking the loop. It is then tripped out into the upper housing, whence it falls through the return chute and drops into the coin return slot.

3.11 When battery feed to the coin service line is normal, it energizes the 78Ω coil of the nickel admitter relay, so that the armature pivots the wire loop out of the channel. A nickel deposited at this time is free to travel the entire length of the nickel channel and actuate the coin trigger. This situation applies on local calls prior to the time the called party answers, but the instruction cards prepared for semi-postpay instruments clearly state that coins should not be deposited at that time, and nickels inserted then are collected without effect. After the called party has answered, battery feed to the coin service line is reversed, current flows through the bypass diode rather than the 78Ω relay coil, and the relay armature restores. This allows the wire loop to enter the nickel channel, so that nickels inserted in an attempt to pay for the local call are returned to the caller, who must use a dime or quarter to remove the transmission impairments and converse. On calls to an operator, battery remains normal, and nickels in any number may be deposited in payment of toll charges.

Two-Nickel Control

3.12 The inconvenience of requiring that a dime be used for a ten cent call was found to outweigh the anticipated disadvantage of two-nickel operation, and another coin chute was designed to accept either a dime or two nickels in payment for a local call. Preference for this arrangment has made it the only surviving option for ten cent service on LPC-series sets. Figure 12 shows the apparatus added to the coin chute, which is fitted with a Micro snap-action switch having a wire operating arm extending through the nickel channel, so that passage of each nickel deflects the arm and operates the switch. A pendulum pivoted above the operating arm is in turn deflected by the arm, which rides against the curved surface of the pendulum. A notch provided in this curved surface is so formed as to permit the operating arm to latch in the operated position as it begins to return from the full extent of its travel. The same sort of relay used in the dime-only chute is here arranged so that an angled extension welded to its armature serves to move the pendulum aside, clear of the operating arm, when the coil is energized. Since the Micro switch is latched by the pendulum, and the pendulum is released by the operation of the so-called "restoring" relay, the latter is herein referred to as the Micro switch latch release relay.

3.13 When battery feed to the coin service line is normal, it energizes the 78Ω coil of the latch release relay, so that the armature holds the pendulum slightly to the left of the Micro switch operating arm. This leaves the arm free

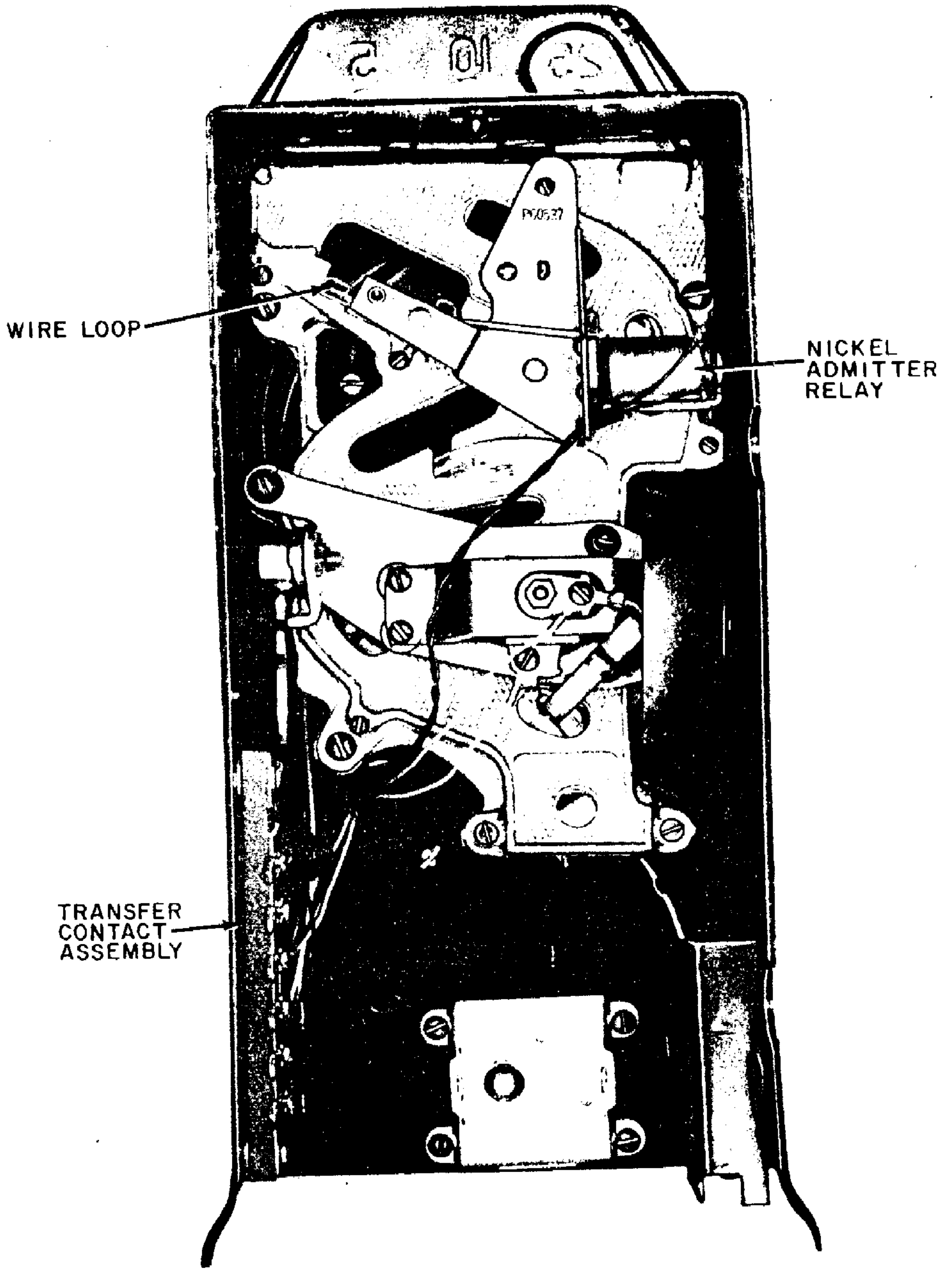


Figure 11. Upper Housing Arranged for Dime-Only Service (Model LPB86-10 or Earlier).

to operate and restore without latching, and its normal position is at point A in the figure, with the contacts open. This situation applies on local calls prior to the time the called party answers, and a nickel inserted at that time trips the Micro switch momentarily but is collected without effect. After the called party has answered, battery feed to the coin service line is reversed, current flows through the bypass diode rather than the 78Ω relay coil, and the relay armature restores. This allows the pendulum to swing to a nearly vertical position. If the station user deposits a nickel, it passes through the nickel channel and strikes the Micro switch operating arm with sufficient force to carry the arm down the edge of the pendulum, past the latching notch. This closes the switch contacts, which on LPC-series sets merely short-circuit the entire transmission circuit of the telephone set, blocking conversation completely. As the nickel passes on down the chute, it permits the switch operating arm to rise, traveling upward along the edge of the pendulum until it reaches the notch and latches in position B as shown in the figure, with its contacts still operated. Thus, although the nickel trips the coin trigger and performs the same functions as in a five cent instrument, the conversation is still blocked. Note that at this point the deposit of a dime or quarter will have no effect in removing the blockage, as the switch operating arm is unaffected by anything but nickel deposits.

3.14 If the station user deposits a second nickel, it strikes the switch operating arm, forcing it downward against the lower inclined edge of the pendulum wedge. This forces the pendulum abruptly to the left as the arm moves first to the lower limit of its travel, and then back up as the nickel passes on down the chute. By the time the pendulum swings back against the operating arm, the arm has risen above the notch and cannot re-latch. It thus restores to normal, opens the switch contacts and removes the short circuit across the network so conversation may proceed. Should the station user lose count and mistakenly deposit a third nickel, transmission will again be blocked until a fourth nickel is inserted, and so on for each odd- and even-numbered nickel deposit.

3.15 On calls to an operator, battery remains normal, and nickels in any number may be deposited in payment of toll charges.

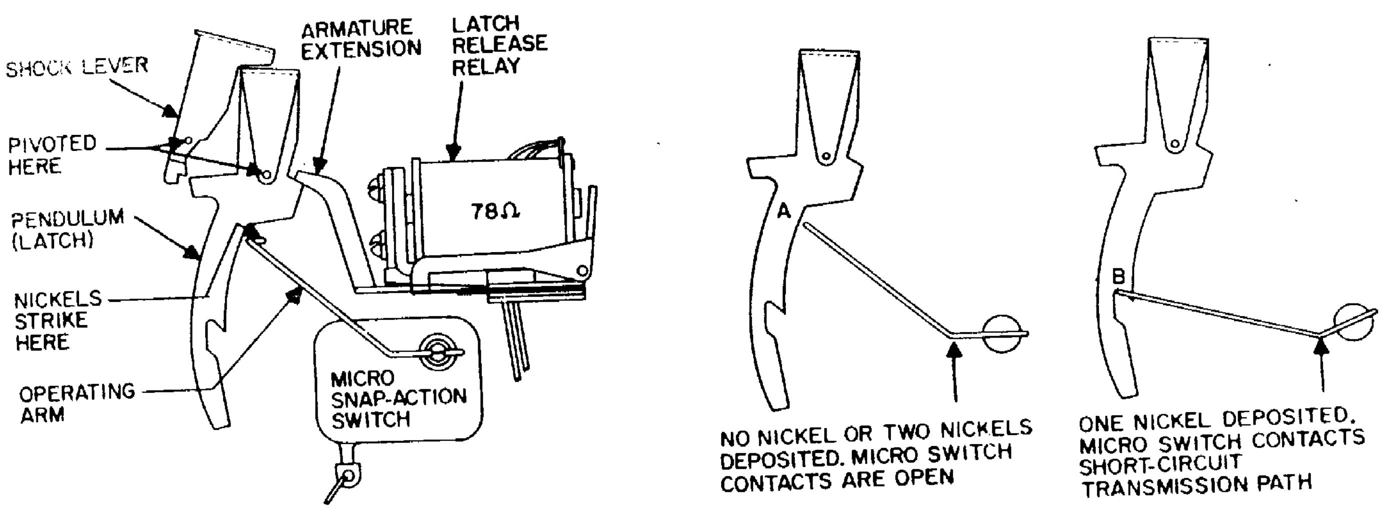


Figure 12. Two-Nickel Mechanism for Ten Cent Coin Chute.