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SINGLE-SLOT COIN TELEPHONE

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COVER ILLUSTRATION—Customers have become accustomed to coin-machines that accept all coins in one slot; they will appreciate this feature of the Single-Slot Coin Telephone. Installers will be pleased at the provisions made to expedite mounting. Management will welcome a new coin-checking mechanism, high-security locks, and many other features that are designed to minimize maintenance and to return maximum revenues to the operating company.

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A SINGLE-SLOT COIN TELEPHONE

by R. J. Hamilton
GTE Automatic Electric Laboratories

In the evolution of the public telephone over a period of more than 60 years, such features as dial operation, anti-sidetone transmission circuits, the one-piece handset, conversion from five-cent to ten-cent service, self-compensating transmission circuits, the printed-wiring transmission network, a single-coil prepay coin relay, and Touch Calling operation—all have been added to a basic design that remained essentially unchanged. While these improvements in the multi-slot set have upgraded public telephone service over the years, it was felt that it was no longer economical or practical to add further improvements to the existing design. The need for a large number of improvements to be incorporated simultaneously suggested the development of a completely new coin telephone. A single coin slot is the most obvious feature of this new instrument, but there are many others.

The new "single-slot" coin telephone (Figure 1) is offered in prepay and semi-postpay models. These will supersede the LPC series multi-slot coin telephones, and will be available in rotary dial and in Touch Calling versions (Figure 2). Housings are of deep-drawn steel, and are so constructed as to discourage "jimmying". Hardened steel at critical points will discourage drilling, and high-security locks protect the housing and the cash vault door. The cash vault is larger than previously used, but it will also accommodate the present standard coin receptacle if desired. A new coin-checking mechanism greatly reduces opportunity for fraudelent use, and the coin return receptacle is so designed that it cannot be "stuffed" to withhold returned coins. These and other features are designed to minimize maintenance and to return maximum revenues to the operating company.

Figure 1—The single-slot coin telephone installed in an outdoor location.

Prepay Operation

When the user lifts the handset to access the central office, dial tone may be returned immediately by the office—or it may be withheld until the initial rate (usually ten cents) is deposited. In either case, the user cannot dial his call until the initial rate is deposited (except that provision can be made for coin-free emergency calling). All coins are inserted into a single coin slot at the upper right front of the telephone; they are then channeled into a rejector mechanism where they are sorted into individual channels, gauged, and tested. If a coin is not accepted by the rejector mechanism, it is either channeled immediately to the coin-return receptacle or held in the mechanism until the user releases it into the receptacle by operating a coin release lever located just below the coin slot.

If the coins meet the tests imposed by the rejector mechanism, they pass into and through a chute section containing three trigger switches—one for each coin denomination. Each of these is briefly closed when a coin of the corresponding

value passes by. These trigger switches are connected to a solid-state printed circuit board "totalizer", which counts the value of the coins deposited and prevents operation until the initial rate deposit has been registered. The first coin passing through the chute triggers the coin relay, operating a set of contacts that prepare a ground path to the transmission network. This action has no effect on the loop, however, until coins representing the initial rate have been deposited; then the totalizer causes a "rate" relay to activate the dial or Touch Calling unit, and extend coin relay ground to the network. The user may then proceed to dial his call. The coins have dropped into the coin relay hopper, where they remain.

On operator-assistance calls, the initial rate is refunded upon connection to the operator. The single-slot set does not use bell and gong signals to indicate coin deposits; instead, an audio oscillator within the telephone generates brief tone pulses that are heard only by the toll operator, and not by the user. On toll calls, collection or return of coins is under control of the operator.

Semi-Postpay Operation

Semi-postpay operation provides fully automatic enforcement of coin collection on local calls in central offices that are arranged for reverse-battery answer supervision. The principal difference between the single-slot prepay and semi-postpay coin telephone sets is that in the latter the hopper is furnished without a coin relay. The collect door in the hopper is latched open, and all coins deposited pass directly through it, into the cash vault. In semi-postpay service, coins accepted by the rejector mechanism are not refunded.

When the user initiates a call, dial tone is immediately extended by the central office, and the user dials his call without depositing coins; thus, if for any reason the call is not completed, it is unnecessary for the coin telephone to refund coins. If the call is answered, the user can hear the called party but he cannot converse because, on reversal of battery, the rate relay has removed the handset transmitter from the circuit. Upon hearing the called party, the user deposits the correct amount of coins, and as accepted by the rejector mechanism, they are counted by the totalizer; when the initial rate has been received, the rate relay reconnects the user's transmitter into the circuit, thereby allowing the calling and called parties to converse.

Figure 2—Single-slot coin telephone sets equipped with (left) Touch Calling unit and (right) rotary dial.

On operator assistance calls, or calls to free-service numbers such as Police or Emergency, battery polarity is not reversed, and the rate relay does not remove the user's handset transmitter from the circuit; thus the caller may converse without making a deposit. If the operator extends the call (e.g., on a toll connection) she of course verifies that she has reached the correct number before requesting the caller to deposit coins. As each coin is deposited, tone pulses indicate its denomination; when the correct amount has been deposited, the operator allows the parties to converse.

Construction

The housing of the new coin telephone set is of all-steel construction and measures 21″ high, 7⅝″ wide and 6″ deep. The upper and lower housings are formed of deep-drawn steel, and contain reinforcing members welded in place. Extra-heavy steel is used for the cash vault door, which also uses reinforcing members. Tongue-and-groove construction at the mating surfaces of the upper and lower housings, as well as between the lower housing and the cash vault door, makes it extremely difficult for unauthorized persons to gain access to the inside of the set. Critical security areas, such as the rim around the cash vault door, are also protected by hardened steel liners which resist attempts to drill into the housing at these points.

The upper housing is retained to the lower housing by movable locking bars located along the two sides of the upper housing. These bars are mechan-

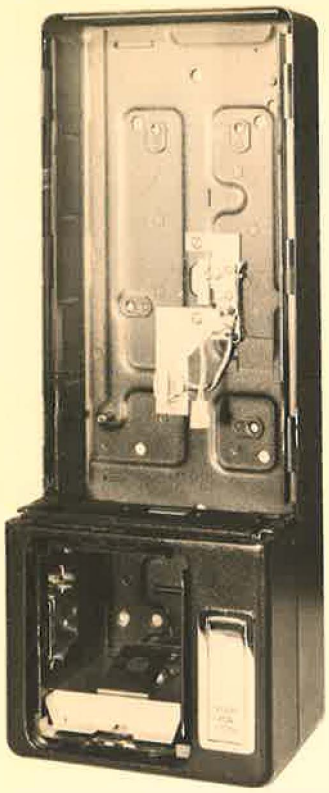

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Figure 3—Lower housing showing internal construction.

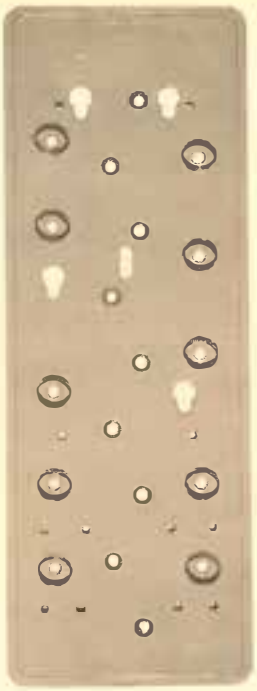

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Figure 4—Metal backboard for surface mounting of telephone.

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Figure 5—Rear view of upper housing, showing locking bars and location of internal components.

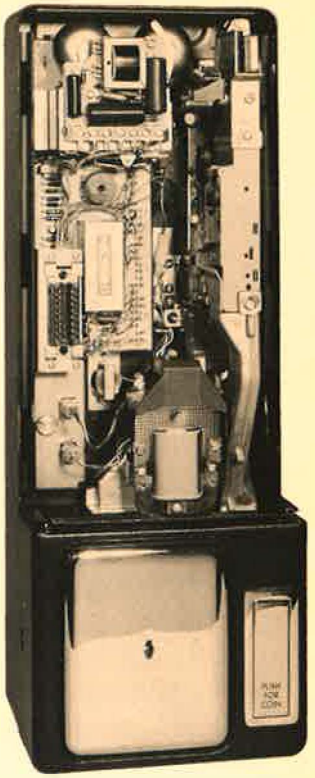

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Figure 6—Lower housing with subassemblies installed.

ically linked to operate together, and they engage at six points with the lower housing (Figure 3). The bars are held in the locked position by a high-security lock located about midway up the right side of the housing; this lock is equipped with a cam-and-stud mechanism that prevents movement of the bars. When this lock has been opened with the proper key, the bars may be operated by the use of a T-shaped tool which is inserted through an opening at the upper right side of the upper housing. The cash vault door is secured by a similar four-point locking mechanism which is engaged by inserting the T-shaped tool into an opening in the center of the door, after opening another high-security lock, located on the left side of the lower housing.

To permit mounting in existing booths or other pre-drilled locations, the pattern of mounting holes in the lower housing, and their relationship to the wire entry opening, is the same as that used on the present multi-slot coin telephone sets. An additional pattern of mounting holes behind the vault area is provided for easier access, and may be used when mounting to a metal backboard (Figure 4). Unlike present sets, however, the lower housing has no rear channel to permit wire entry from top or bottom in surface-wired installations. For this and other installation requirements a metal backboard is used to secure the coin telephone and provide the channels needed for surface mounting. Provision is made for use of four security studs which aid in mounting the telephone as well as provide a more secure installation.

The cash vault has been enlarged to accommodate a new coin receptacle with approximately 50% greater capacity than the one used in multi-slot coin telephones. However, to accommodate the smaller standard receptacle, a false floor and support spring are installed in the cash vault; these may be removed if the larger receptacle is used.

The coin return receptacle is provided with a top-hinged door at the right front of the lower housing. Returned coins enter from a passage behind the door, and collect just below the bottom of the door (the floor of the receptacle extends to the rear and upward to form a trough for holding coins). When the door is opened, coins are accessible to the customer while the passage by which coins enter the receptacle is blocked off. The rear-

ward extension of the trough appears to be the passage from which coins enter, but it may be stuffed to no avail since the actual passage is protected from stuffing by the opened door.

Within the lower housing, provision is made for mounting switches at two points, for activating alarms in the event of unauthorized entry. One switch may be positioned with its actuator bearing on a locking bar of the upper housing, and the other with its actuator bearing on the similar mechanism of the cash vault door.

The upper housing (Figure 5) contains a dial housing to which is mounted the rotary dial or Touch Calling unit and the switch lever and hookswitch, together with a terminal board and a plug with 16 ribbon contacts. Leads from the various components and the plug are interconnected at the terminal board. As the upper housing is pushed into place, the dial housing plug makes contact with a float-mounted receptacle in the lower housing, thus obviating the problem of trying to insert a separate plug while holding the upper housing in position.

A stationary handset hanger is mounted on the front of the upper housing. Through an opening in the housing between the support points of the hanger, a hookswitch lever projects by which the hookswitch springs are operated; springs are bifurcated, using bar contacts. Unlike those in previous coin telephones, the hookswitch springs do not disconnect the ringer from the line while the instrument is in use; thus it is possible to re-ring the set even if it is off-hook. An armored handset cord is furnished as standard; to minimize tangling, it enters on the left side of the housing.

The upper housing is designed to accept either a dial or a Touch Calling unit by proper choice of porcelain-enamel finished dial plate. Rotary dial coin telephone sets use a non-lighted version of the Type 54 dial with three makes in the off-normal spring assembly, while the Touch Calling instruments are equipped with a special weather-protected Touch Calling unit. Field conversion from dial to Touch Calling operation requires simply the replacement of the upper housing, which can then be converted in the shop. On rotary dial coin telephone sets a clear polycarbonate fingerwheel is used in conjunction with an adapter which provides greater rigidity in mounting; the fingerwheel lies nearly flush with the faceplate, making it less susceptible to prying.

The faceplate of the upper housing has two openings for recessing instruction cards. An upper instruction card, 2″ x 2¾″ in size, is located to the left of the coin slot and provides information on how to operate the coin telephone set, while a 2½″ x 6⅛″ lower panel card furnishes service codes and other call data individual to a given area. The cards and their clear plastic windows are arranged for snap-in mounting on the faceplate.

Standard finish for the upper and lower housings is a vinyl paint which is highly resistant to abrasion and chemical attack. Light texturing of the finish provides a pleasing appearance while it also conceals welding marks where internal parts are anchored to the housings. The handset hanger, coin return receptacle, vault door, faceplate and coin release lever are all chrome-plated.

Subassemblies

Within the telephone (Figure 6) are three major assemblies retained in such a manner that they are easily removed. First, mounted at the top right of the lower housing is the rejector mechanism with its coin release linkage and lead-in chute. The rejector is fastened to a mounting plate which is held in place by a tab and one captive screw. A reject chute (connecting the rejector and coin relay return outlets to the coin return receptacle) is also removable by loosening one captive screw.

Second, a coin relay, hopper, and chute assembly located below the rejector mechanism is retained near the top by a tab that drops over an opening in the reinforcing plate at the rear of the lower housing. The collect opening of the hopper extends through the floor above the coin box and is locked in place by a movable rail.

Third, a chassis assembly mounted at the left side of the lower housing is retained by a tab and one captive screw. Mounted to the chassis is the transmission network, a Type 45 ringer and the three printed circuit boards of the totalizer. A float-mounted connector with 16 ribbon contacts provides circuit access to the components in the dial housing, a four-pin connector offers connection to the coin chute triggers, a three-pin connector affords connection to the coin relay, and a three-pin connector and terminal block located on the right side of the chassis provides connection to line terminations on the rear housing.

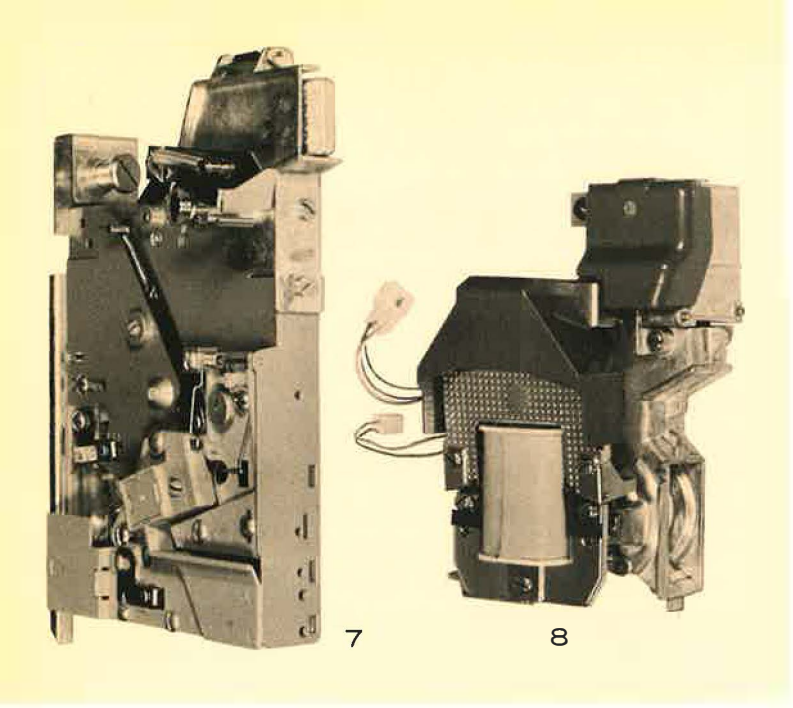

Figure 7—Rejector mechanism removed from lower housing.

Figure 8—Coin relay, hopper and coin chute assembly.

Rejector Mechanism

The rejector mechanism (Figure 7) is a sophisticated coin-testing device for accepting genuine coins only and rejecting all others. As coins enter the rejector, they are sorted into the three general sizes—quarter, nickel, and dime; thereafter, coins of each size are tested in their own individual channel. Each coin is first checked for proper diameter and weight. If it meets these requirements it is checked for a perforation (such as a washer) and is released down an inclined rail. As the coin rolls down the rail it is tested for proper thickness and then passes by a permanent magnet. The magnet generates eddy currents within the coin if it is metallic, and this tends to retard its travel. If it is not metallic (for example, a plastic slug) there is no slowing as it passes the magnet. The composition of the coin determines the speed with which it leaves the inclined rail; if it travels too fast or too slowly, it will strike certain deflectors that cause it to be diverted to the reject outlet. In addition, each nickel-size coin is tested for hardness and elasticity.

Most rejected coins will be diverted directly into the reject outlet, which ends in the coin-return receptacle of the telephone. Ferrous slugs, oversize coins, and washers become trapped in the rejector but can be released by operation of the coin release lever. As this lever is operated, it causes separation of the hinged sides of the lead-in chute and rejector; this allows several fingers to extend into the coin channels and dislodge trapped coins. At the same time, wiper blades sweep past the magnets to clear the coin channels, directing the trapped coins to the coin return receptacle.

Coin Relay, Hopper, and Chute

Coins leaving the rejector mechanism have been sorted into three channels. As each coin travels through the succeeding chute section, it operates the trigger switch associated with that denomination—and each trigger provides an input to the totalizer (as mentioned previously, the first trigger to operate actuates the coin relay trigger lever). After passing through the chute section, coins fall into the coin relay hopper and are channelled directly into the coin box (in semi-postpay service) or come to rest on a double trapdoor support (in prepay service).

The prepay coin relay (Figure 8) serves to dispose of the coins held suspended on the trapdoors. The hopper is wider than previously used, so it can accept coins from an off-center entry point and retain them in random fashion; this allows the hopper to be shorter, but with the same capacity (approximately 20 quarters) as the single-coil coin relay used in multi-slot sets[1]. Similar in operating principle to that relay, the new prepay relay also features a polarized selector mechanism. During operation of the relay, the selector card is influenced by the polarity of the voltage applied to the relay; this causes the card to tilt to either the right or the left as it moves downward, and open the proper trapdoor either to collect or to refund the coins. Release of the relay resets the trigger lever and returns the trapdoor to the closed position in readiness for another deposit.

As the relay operates, it short-circuits its own coil and substitutes a resistor in the circuit during

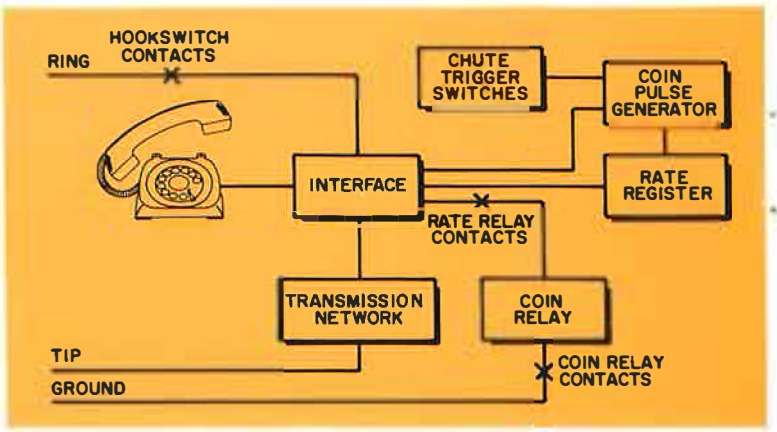

Figure 9—Block diagram of coin telephone circuit.

the shorted period. The resistor provides circuit continuity and current limiting for the operator's coin lamp, while the coil-shorting feature allows the relay to operate completely on a 0.2 second pulse. The shorted coil also provides a long release time to insure complete disposal of coins.

Totalizer

The primary job of the totalizer is to count and store the total value of the coins deposited—but it also performs several other functions. As coins are received, the totalizer simultaneously mutes the coin telephone receiver and applies audio frequency signals to the line; on operator-assisted calls these tones indicate the value of each coin deposited. The totalizer also controls the coin telephone by restricting either signaling or transmission until the initial rate has been deposited (Figure 9). The initial rate is set at the factory for 10 cents but can be easily revised for any value from 5 cents to 35 cents in 5 cent steps, by changing the position of three wiring straps.

The totalizer (Figure 10) is comprised of three printed circuit board assemblies—the coin pulse generator, the rate register, and the interface circuit. When a deposit is made, signals from the coin triggers are fed into the coin pulse generator, where pulses of the proper number and duration are produced, corresponding to the values of the coins deposited. These pulses are sent simultaneously to the rate register and the interface circuit. The rate register counts them, while the interface converts them to tone signals and applies them to the telephone line. To mute the receiver, a continuous output is also sent from the coin pulse generator to the interface circuit during the entire pulsing period; this minimizes the level of coin tones reaching the user's ear, and also reduces the possibility of fraudulent usage of these tones. When the total number of pulses stored in the rate register equals the initial rate for which it is set, the rate register signals the interface circuit, which responds to make the telephone operative.

The interface circuit serves to make the logic section of the totalizer (coin pulse generator and rate register) compatible with the conventional telephone circuit. Included in the interface circuit are a regulated power supply, operated from line potential, to power all other totalizer circuits; an audio oscillator which the coin pulse generator keys as each coin is deposited; a receiver-muting

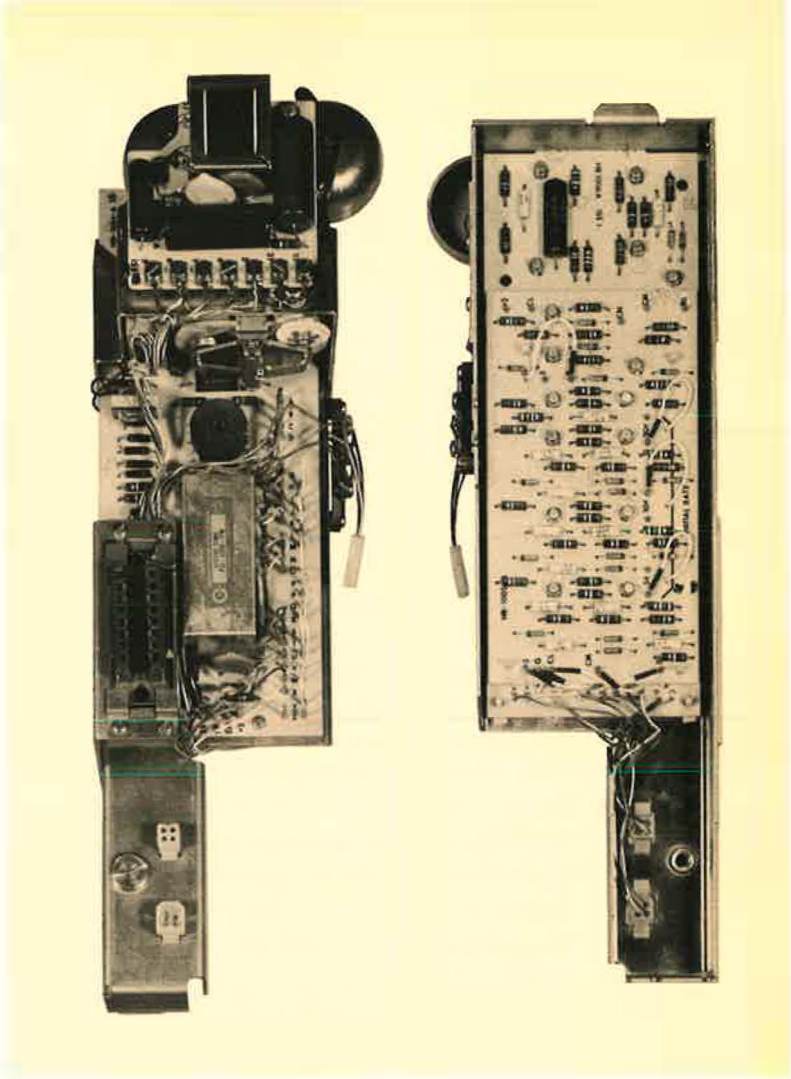

Figure 10—Front and rear views of chassis assembly.

control which is activated during the sending of tones; a unity-gain one-way amplifier (used to isolate the receiver to prevent its use as a transmitter in semi-postpay service); and a rate relay and associated circuit to control the dial or Touch Calling unit, the coin relay and the transmitter. Three modes of operation are possible by changing the position of several straps on the interface circuit and one strap on the rate register.

Standard Prepay Mode

In this mode one winding of the rate relay is energized by loop current as soon as the telephone goes off hook; its contacts open a path from the coin relay to the telephone network, and disable the dial or Touch Calling unit. Closure of the coin relay contacts on deposit of the first coin has no effect on the loop unless that coin satisfies the initial rate for which the totalizer has been strapped. When the total deposit equals or exceeds the initial rate, an output signal from the register causes a second winding of the rate relay to be energized while the first is de-energized. Rate relay

contacts now transfer and the dial becomes operative, while coin relay ground is extended to the telephone network for detection by the central office.

Emergency Calling Prepay Mode

If the instrument is used for coin-free emergency calling service, strapping on the interface board is arranged so that the dial or Touch Calling unit is not disabled, and rate relay contacts do not transfer immediately upon full deposit. When a call is initiated, the central office briefly opens the ring conductor at the appropriate time to check for proper deposit. If the initial rate has been deposited, this interruption in loop current will cause the second winding of the rate relay to be energized from the interface power supply while the first winding will be de-energized. Rate relay contacts then transfer and apply coin relay ground to the network, providing a detection path from the tip conductor to ground. The central office detects the coin relay ground and will allow the call to be completed. After the brief detection period, the ring conductor is closed by the central office and loop current again flows, causing the rate relay to transfer its contacts and once again open the coin relay ground path. Absence of the coin relay ground connection for the duration of the call minimizes the longitudinal current induced in the line from external sources, and thereby reduces hum and noise during conversation. (The advantages of this type of operation can, of course, be realized only when the single-slot coin telephone is used with central office equipment that is designed for emergency calling service.)

If no deposit or only a partial deposit has been made, the rate relay remains energized from the interface power supply during the detection period and does not transfer its contacts, but maintains the coin relay ground open. With some central office equipment, the detection period may be longer than the time that the power supply can energize the rate relay; however, the contacts still remain in the same state because of their bi-stable characteristic. Thus, the central office does not detect coin deposit and the call is blocked — unless it was placed to an emergency or free number (in which case the central office is programmed to complete the call even though no coin has been detected).

Semi-Postpay Mode

If strapping on the interface and rate register boards is arranged for semi-postpay operation, one winding of the rate relay is energized by loop current from normal battery. Relay contacts then connect the handset transmitter (and, in Touch Calling sets, the Touch Calling unit) to the network for service. This permits proper operation on calls to free-service numbers or to an operator (on which battery feed remains normal).

Receipt of reverse-battery supervision on a completed call to a local number causes the second winding of the rate relay to be energized while the first winding is de-energized. Contacts of the rate relay now transfer, disconnecting the transmitter (and, in Touch Calling sets, disabling the Touch Calling unit to prevent its use for transmission of coded information). At this time, the receiver is fully operative with normal sensitivity, so the called party's answer can be heard without impairment, but a unity-gain amplifier isolating the receiver from the network induction coil prevents use of the receiver as a transmitter. Deposit of the initial rate for a local call causes the rate register to signal the interface circuit to energize the first winding and de-energize the second winding of the rate relay. This causes the rate relay contacts to transfer once again and reactivate the transmitter and (in Touch Calling sets) the Touch Calling unit.

Other Circuit Features

In either mode of prepay service, coins may be collected or refunded at any time, even though the coin relay connection may be held open by the rate relay. Application of coin battery to the line causes the control circuit of the rate relay to energize and de-energize the appropriate windings and transfer the rate relay contacts so as to connect the coin relay to the network for coin disposal.

The single-slot set will operate with offices that send coin battery over one side of the line only, or over both sides simultaneously. This feature allows the set to be used in offices that still serve multi-slot sets having the older two-coil coin relay, which requires the higher current provided by paralleling the loop conductors. It also allows use of the set in offices that serve other coin telephones which may require coin battery to be sent over one side of the line only.

To permit use of the instrument in either prepay or semi-postpay service, reset of the totalizer to zero at the end of each call is triggered as the loop is opened on disconnect. Reset occurs after a slight time delay, thus precluding undesired resetting on an accidental hookswitch flash by the user, should this occur prior to completion of dialing. The reset delay is short enough, however, to prevent seizing a new line before the totalizer has been reset.

For semi-postpay service, or for prepay service where normal polarity is maintained to the telephone set, a special Touch Calling unit makes it impossible to generate single tones by operating two keys in simulation of coin deposit tones, if this were attempted on operator calls. If reverse-battery supervision is returned in prepay service (such as on a call being served from a TSPS installation), the Touch Calling unit will be disabled, as a further measure to prevent its use to simulate coin deposit tones.

Summary

Because of its improved construction and high security locks, the single-slot coin telephone is expected to offer advantages over the multi-slot set in its increased resistance to vandalism and theft. Use of a sophisticated rejector mechanism and new circuit features should reduce fraudulent usage of the set—and future requirements may be easily accommodated for higher initial calling rates, emergency calling prepay operation, conversion from semi-postpay to prepay operation or from rotary dial to Touch Calling service, and machine recognition of the more precise coin tones. These features should extend the service life of the set and result in greater operating economies for the telephone company.

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[1] *"Improved Coin Telephone Provides Greater Range and Coin-Handling Capacity"*—R. J. Hamilton, Automatic Electric Technical Journal, January 1968.

RICHARD J. HAMILTON was graduated from the University of Illinois in 1958 with a degree of Bachelor of Science in Mechanical Engineering, and joined GTE Automatic Electric the same year. Through the Company's training program, he gained experience in various departments and later joined the Laboratories as a staff engineer working on relays and telephone component design. Mr. Hamilton is currently a senior engineer in the Electromechanical Design Group of the Materials and Apparatus Division and is responsible for coin telephone design. He holds one U.S. patent on a coin relay device.

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