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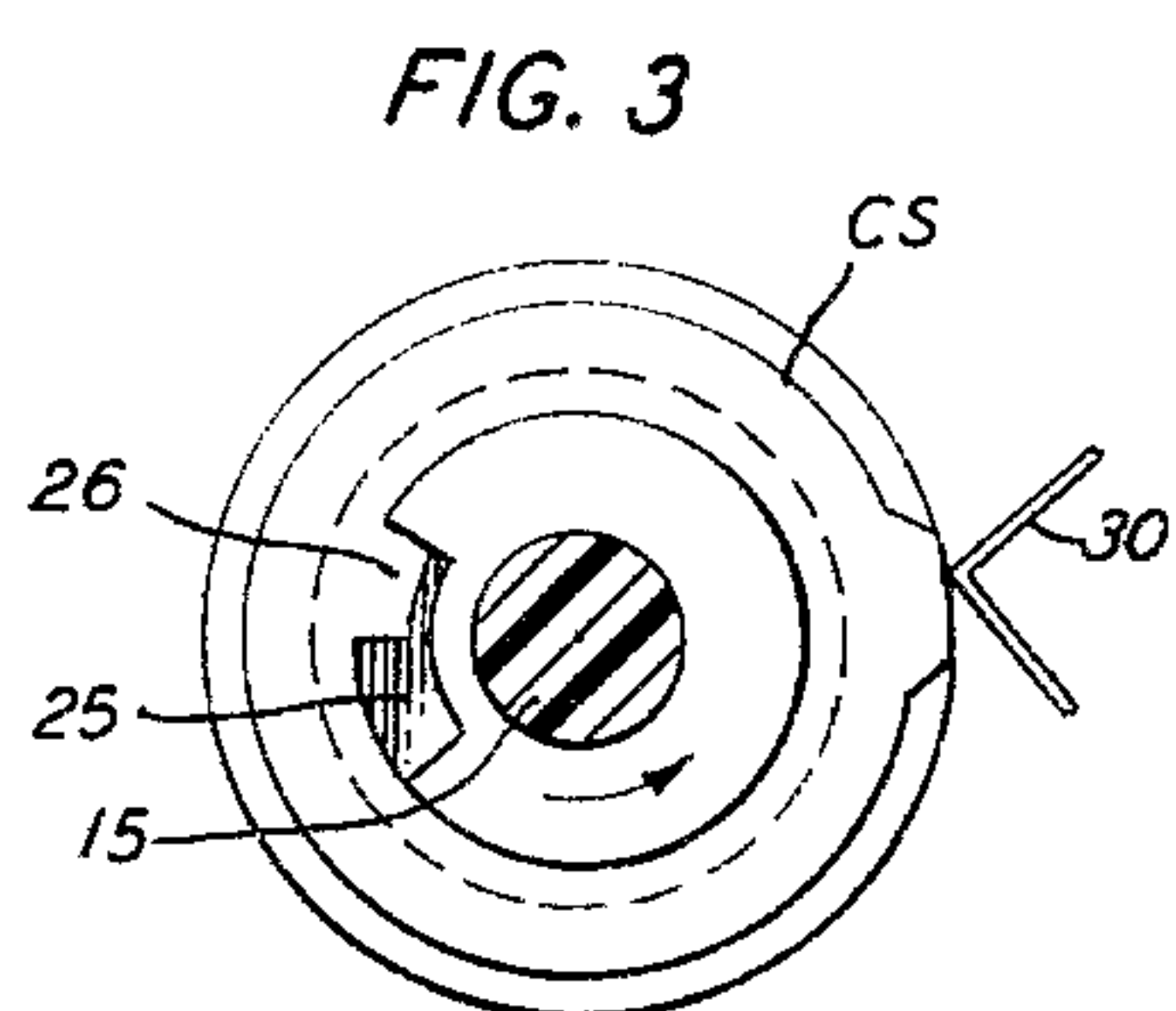
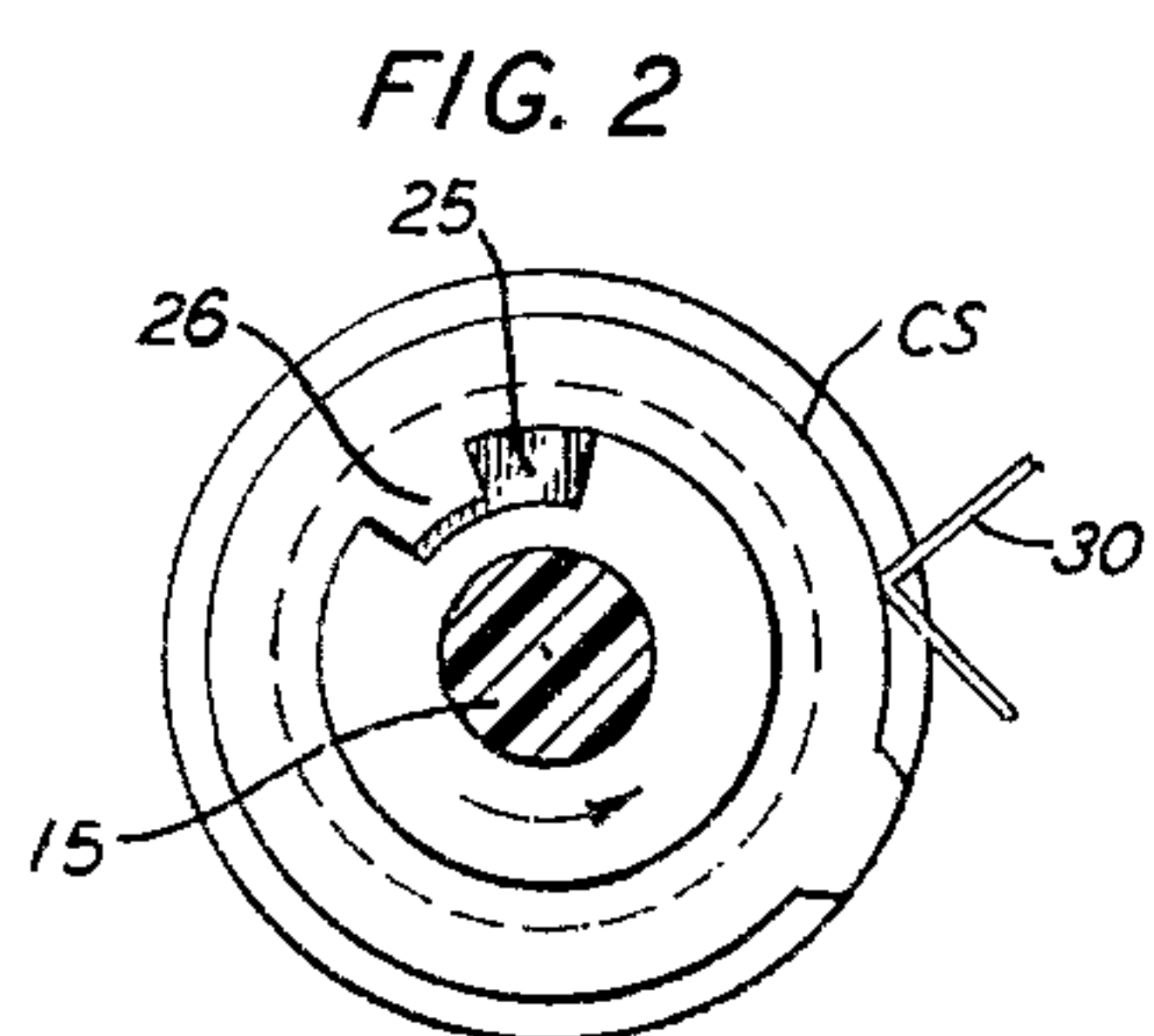
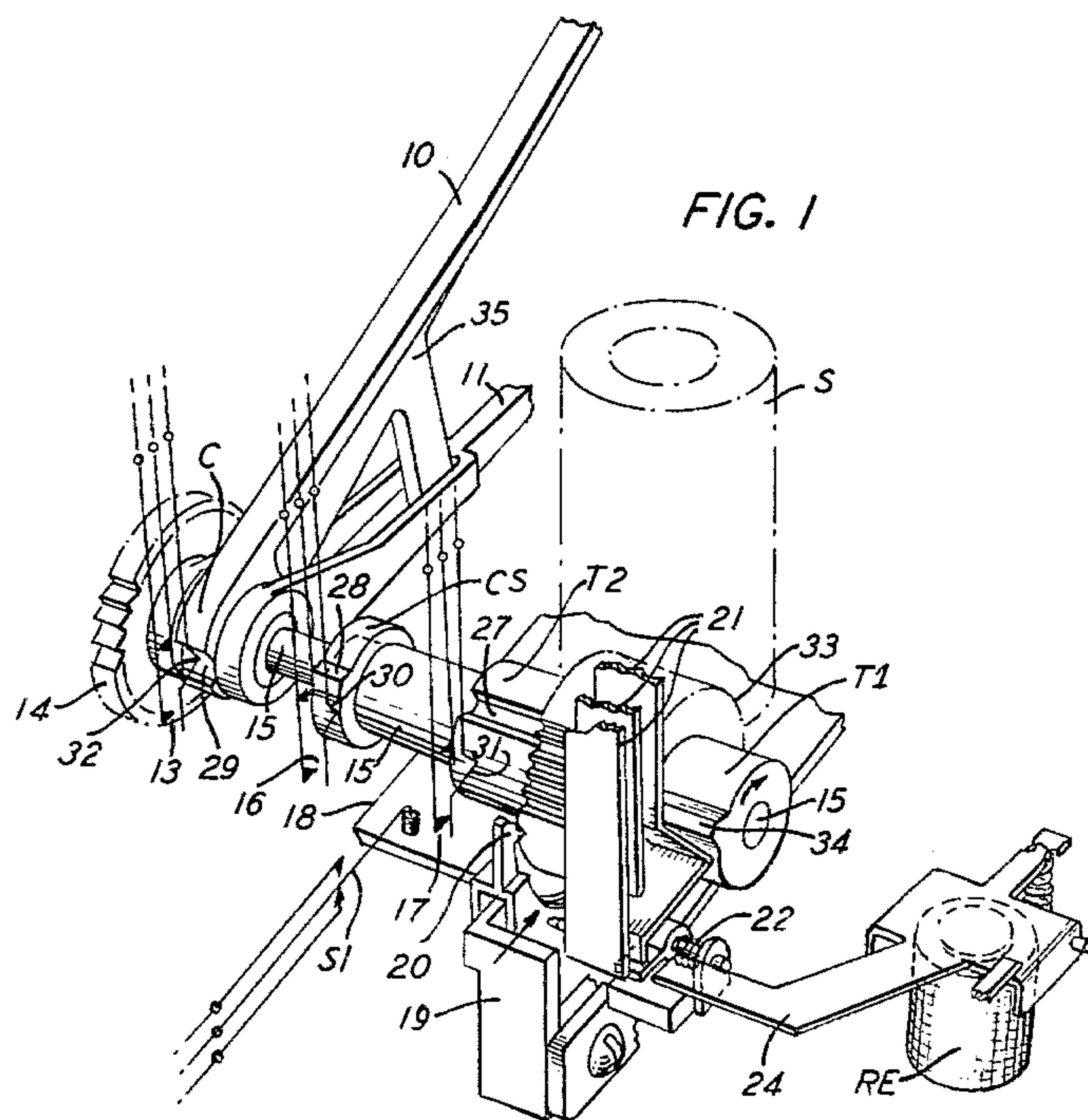
E. R. ANDREGG ET AL

3,239,609

COIN TELEPHONE CONTROL APPARATUS

Filed Sept. 18, 1962

2 Sheets-Sheet 1



INVENTORS: E. R. ANDREGG
K. E. VOYLES
BY *E. J. Oliver*
ATTORNEY

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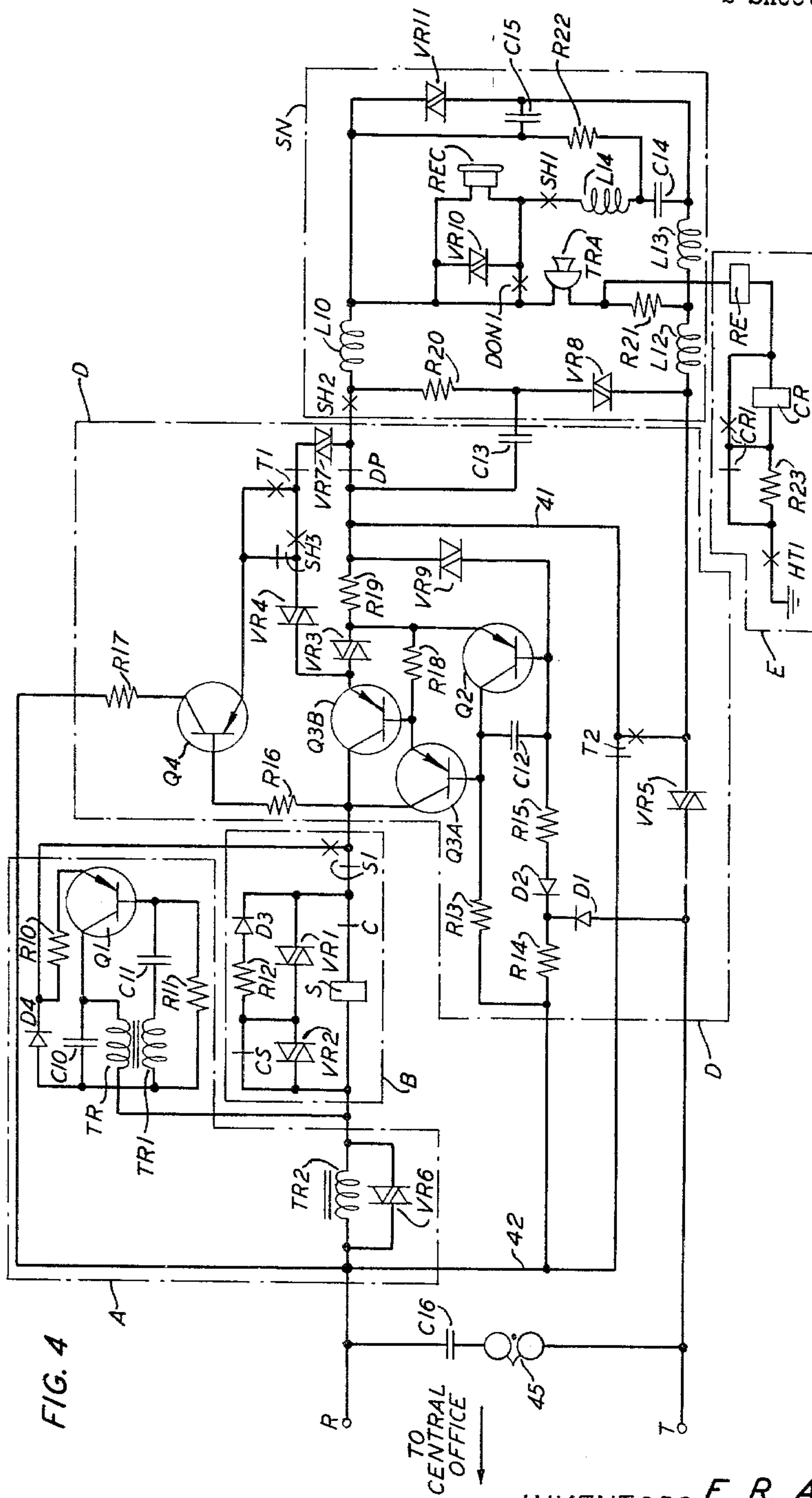
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COIN TELEPHONE CONTROL APPARATUS

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2 Sheets-Sheet 2



INVENTORS: E. R. ANDREGG
K. E. VOYLES

BY

E. J. Olander

ATTORNEY

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COIN TELEPHONE CONTROL APPARATUS

Ernest R. Andregg and Kennard E. Voyles, Indianapolis, Ind., assignors to Bell Telephone Laboratories, Incorporated, New York, N.Y., a corporation of New York
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16 Claims. (Cl. 179—6.3)

This invention relates to coin operated telephones and more particularly to the control apparatus employed in such instruments. Its general object is to improve coin telephones in both flexibility and reliability.

Despite the long standing, effective and widespread use of coin telephones, a number of problems in this field have not been solved fully by prior art arrangements. One continuing problem, for example, lies in the generation and interpretation of coin identification signals. Ideally, such signals should be free from all possible ambiguity and the generating equipment should be compact, reliable and modest in cost. Additionally, the nature of such signals should preclude fraudulent or inadvertent imitation.

Another problem relates to the necessity of foreseeing and preventing all possible fraudulent practices by which telephone service may be obtained at no cost or at less cost than the legally fixed rates. In addition to the simulation of coin identification signals, such practices may, for example, include the introduction of false grounds at various points in the control circuitry and at various times during the operating sequences of the coin telephone.

The introduction of any modification to coin telephone control apparatus raises the problem of maintaining full compatibility with the corresponding central office control circuitry. If such compatibility is not maintained, the cost of central office modifications may well outweigh the economy or other advantages sought from the station set changes.

Accordingly, a specific object of the invention is to increase the reliability of coin identifying signals generated by coin telephones and to simplify the signal generating equipment associated therewith.

Another object is to reduce the complexity of coin telephone control apparatus.

A further object is to increase the protection against fraudulent operation of coin telephones without sacrificing compatibility with existing central office equipment.

These and other objects are achieved in accordance with the principles of the invention by a coin operated telephone comprised broadly of a totalizer mechanism and associated electronic control circuitry. The totalizer mechanism comprises a shaft which is rotatably responsive to the deposit of coins after the coins have been passed as genuine by a coin chute mechanism. The degree of rotation imparted by each coin to the totalizer shaft is indicative of the value of the coin. The control circuitry which is associated with the totalizer mechanism is designed to perform a number of functions which include unshorting the dial for operation after some minimum initial deposit of predetermined value, establishing a path for the receipt of dial tone upon the receipt of an initial minimum deposit and the generation and transmission of signals to the central office indicative of the value of each of the deposited coins. These and

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other functions of the control circuitry are initiated in accordance with a predetermined time sequence by electrical contacts which are operated by cams mounted on the totalizer shaft.

In effect, in accordance with the invention, the totalizer shaft stores coin information as it rotates. The reading out of this stored information is accomplished by resetting the shaft to its initial or index position. This resetting function is performed by an electromagnetic stepping motor which is energized through the operation of suitable totalizer cam operated contacts after the deposit of a coin or coins equal in value to the initial rate. The stepping motor includes an armature which is in driving relation to an operating pawl which is in turn arranged for engaging relation with a ratchet drive wheel mounted on the totalizer shaft. Self-interrupting contacts driven by the stepping motor armature provide the desired stepping action.

In accordance with the invention the armature of the stepping motor performs a second function in that on each operating cycle it actuates a set of contacts to complete a path for the application of current to an oscillator circuit. The oscillator is employed to generate tone bursts which are indicative of the value of deposited coins. During the reset the stepping motor drives the totalizer shaft in ten degree increments and each such increment corresponds to a five cent deposit. Consequently, the oscillator is made to generate a single tone burst for each nickel deposit, two such tone bursts for a dime and five tone bursts for a quarter.

In accordance with another aspect of the invention, coin signals transmitted to the central office are coded not only in terms of the number of tone bursts employed to represent a particular coin but also in terms of the signal repetition rate of these tone bursts. Specifically, in accordance with the invention, circuitry is included which provides for a slow tone pulsing rate for signaling a dime deposit and a fast pulsing rate for signaling a quarter deposit. The dual rate signaling has two distinct advantages, the first being that it greatly facilitates accurate recognition of coin deposits by central office operators. Improvement in identification is provided not only by the distinctiveness in pulsing rate but also by the accompanying increase in the silent interval between the signals resulting from sequential deposits which include one or more quarters. Secondly, the relatively rapid signaling for a quarter deposit avoids or minimizes a jam-up of coins if a coin is inserted during the totalizer reset operation resulting from a quarter deposit.

Broadly, dual rate signaling is accomplished in accordance with the principles of the invention by controlling the impedance across the windings of the stepping motor. During totalizer reset a speed control cam mounted on the totalizer shaft is permitted to slip on the shaft bearing for the first twenty degrees of shaft rotation which corresponds to a dime deposit. When a quarter is deposited, however, the corresponding totalizer reset action drives the shaft beyond the twenty degree slip angle of the speed control cam and the cam is rotated, opening a set of speed control contacts which switch additional impedance elements across the stepping relay, thereby raising the stepping motor reference voltage. The new reference voltage permits the stepping motor to operate at the faster rate. Despite the faster pulsing rate achieved

thereby, however, the duty cycle of the pulses is unchanged.

In accordance with a further aspect of the invention, increased protection against electrical fraud is provided. Heretofore, it has been possible on occasion to operate a coin telephone fraudulently by introducing a false ground. In accordance with the invention, a cam on the totalizer shaft is employed to short out the dial pulse contacts until the initial rate is deposited. Prior art arrangements typically have employed, instead, a set of dial shorting contacts on the coin relay. False ground protection is achieved in accordance with the invention without regard to the initial rate, however, and further is achieved without introducing other opportunities for electrical fraud. For example, in certain prior art arrangements electrical fraud can be accomplished through manipulation of the switchhook or dial pulse contacts or by depositing coins at particularly selected times.

Another aspect of the invention concerns the use of transistor logic circuitry to achieve central office compatibility. A conventional negative potential start signal on the ring lead is utilized and hence there is no requirement for modification of the associated central office coin telephone control equipment. The employment of transistors in lieu of relays is of course desirable from the standpoint of conservation of power and also from the standpoint of economical use of available space.

Accordingly, one feature of the invention pertains to the generation and transmission of single duty cycle tone pulse coin identification signals which are indicative of the value of deposited coins both in terms of the number of pulses and in terms of pulse repetition rate.

Another feature of the invention involves a totalizer driven cam which operates electrical contacts to remove a shorting path from the dial pulse contacts after the deposit of a preselected initial rate.

Another feature of the invention lies in coin telephone control apparatus employing transistor logic circuitry to maintain central office compatibility. Thus, as in prior art arrangements, a negative potential on the ring lead is employed as a start signal.

The principles of the invention together with additional objects and features thereof will be fully apprehended from a consideration of the following detailed description of an illustrative embodiment of the invention and from the appended drawing in which:

FIG. 1 is a perspective view of coin telephone totalizer apparatus in accordance with the invention;

FIGS. 2 and 3 are cross-section views of the totalizer mounted pulsing-speed control cam shown in FIG. 1; and

FIG. 4 is a schematic circuit diagram of the control circuitry operatively associated with the totalizer of FIG. 1.

TOTALIZER STRUCTURE

The totalizer structure shown in FIG. 1 comprises totalizer shaft 15 and cams C, CS, T2 and T1 mounted thereon. Shaft 15 is rotated by the cooperative action of coin arms 10 and 11 and ratchet wheel 14. Coin arms 10 and 11 which are mounted for free rotation on shaft 15 protrude into a coin chute (not shown). Coins in the channels of the coin chute are directed to impinge against the upper surfaces of coin arm 10, in the case of quarters, and against coin arm 11, in the case of nickels or dimes, thus driving the coin arms downwardly. Any rotation of coin arm 11 causes coin arm 10 to rotate also by bearing downwardly on connecting bar 35. Coin arm 10 pivots on shaft 15 independently of coin arm 11, however. The rotation of coin arm 10 is translated by means of a drive spring, not shown, affixed to coin arm 10, into a rotational movement of ratchet wheel 14 which in turn rotates shaft 15. Such coin arms in combination with a ratchet wheel totalizer shaft drive are described in detail in patent application Serial No. 206,265, filed June 29, 1962, by D. W. Peat and L. A. Strommen.

The hub of coin arm 10 forms a cam C with a camming notch 29. Rotation of coin arm 10 raises contact spring 32 out of notch 29 to operate contacts 13. The operation of contacts 13 is employed to disable electrically stepping motor S which is used to drive totalizer shaft 15 in the opposite direction during read out. Any possibility of locking or jamming the totalizer mechanism by having the coin arms drive the shaft 15 in one direction with the stepping motor operating to drive shaft 15 in the opposite direction is thereby eliminated.

Cam CS, mounted on shaft 15, includes cam lobe 28 which operates contacts 16. Cross-section views of cam CS are shown in FIGS. 2 and 3. Shaft 15 includes a keyway 25 accommodating an internal key 26 on cam CS. In the index or normal position the relation between cam CS and shaft 15 is as shown in FIG. 2. It is evident that shaft 15 is free to rotate through an arc of approximately 20 degrees before engaging cam CS. At the end of approximately 20 degrees of counterclockwise rotation, as shown in FIG. 3, shaft 15 engages cam CS and contact spring 30 is lifted by cam lobe 28 to operate contacts 16.

The totalizer shaft driving arrangement comprised of coin arms 10 and 11 and ratchet wheel 14 is designed to drive shaft 15 through an arc of approximately 10 degrees for each nickel deposited. Accordingly, neither the deposit of a nickel nor the deposit of a dime operates cam CS. The deposit of a quarter, however, rotates shaft 15 through an angle of approximately 50 degrees, rotating cam CS and operating contacts 16. Contacts 16 are employed in the control circuitry in a manner described in detail below to provide for the generation of coin identification signals at a relatively slow rate in the case of dimes and at a relatively fast rate in the case of quarters.

Cam T2 which may be integral with or fixedly mounted on shaft 15 includes a camming notch 27. When shaft 15 is in the so-called "normal position," that is to say the shaft position before the coin arm mechanism or after the stepping or read out mechanism has operated, contact spring 31 of contacts 17 is engaged by notch 27. In the off-normal condition, however, contact spring 31 is shifted to the high portion of cam T2 and contacts 17 operate in the control circuitry to short the telephone set and to introduce stepping motor S into the circuit. Thus when cam T2 is in the normal position stepping motor S is shorted by T2 cam contacts 17 and the telephone set is returned to the circuit.

Read out of the coin deposit information which is stored by totalizer shaft 15 in terms of its rotational position, is accomplished by driving ratchet wheel 33 in incremental steps of 10 degrees in the direction shown by the small arrow on shaft 15 until shaft 15 has returned to the normal position. The stepping of ratchet wheel 33 is accomplished through the action of armature 18 of stepping motor S. Armature 18 actuates toggle 20 through connecting link 19 and toggle 20 is arranged to engage the teeth of ratchet wheel 33 in driving relation. Self-interrupting contacts S1, operated by armature 18, control the stepping action of stepping motor S. A substantially similar coin telephone totalizer stepping mechanism is described in detail in patent application Serial No. 209,134, filed July 11, 1962, by D. W. Peat, L. A. Strommen and R. K. Thompson, Jr.

Cam T1 which includes cam lobe 34 is also referred to as the initial rate setting cam in that its relative rotational position upon installation determines the value of the initial rate. Cam T1, in conjunction with contacts (not shown), mounted on contact springs 21, provides switching for dial shorting until the initial rate is deposited and enables the control circuit to alert the central office of a "start" condition when this rate is satisfied. Shaft 15 must turn through some preselected angle of rotation which corresponds to the initial rate before

contact springs 21 and their associated contacts are engaged by lobe 34 of cam T1.

When contact springs 21 are raised through the action of lobe 34 of cam T1, a spring loaded latch member 22 is allowed to fall beneath springs 21, thus maintaining the associated contacts in the operated position when cam T1 and shaft 15 are rotated back to the normal position by the stepping mechanism. Latch mechanism 22 is returned to normal through the action of a reset electromagnet RE and its associated armature 24 whenever the coin relay (not shown) is operated since, as will be described in detail below, the coin relay and the reset electromagnet are in series relation in the control circuit.

CIRCUIT CONFIGURATION

In FIG. 4 the circuitry associated with the totalizer mechanism is illustrated by conventional detached contact notation in which an "X" denotes a make contact and a bar "—" indicates a break contact. To assist in correlating the description of the totalizer mechanism with the description of the associated circuitry, contacts in FIG. 4 operated by the totalizer cams are identified by the corresponding cam designations rather than the contact designations employed in FIG. 1. The circuit shown in FIG. 4 may be classified broadly in terms of subcircuits which include an oscillator circuit A, a coin identification signal speed control circuit B, a telephone speech network C, an operating control and logic circuit D and a coin relay and reset relay circuit E. Oscillator circuit A, which generates tone pulse coin identification signals, employs a transistor Q1 with conventional collector-to-base coupling provided by transformer coils TR and TR1 and by capacitor C11. Oscillator A also includes a frequency determining capacitor C10 and biasing resistors R10 and R11. Diode D4, bridged between ring lead R and one terminal of emitter-biasing resistor R10 establishes a fixed reference voltage for oscillator A and also provides a holding path for central office supervisory circuits. Oscillator output is applied to ring lead R by additional transformer winding TR2 shunted by a click suppressor varistor VR6.

The coin identification signal speed control circuit B includes the coil of stepping motor S which is in series with ring lead R. The rate at which stepping motor S operates is determined by the reference voltage across it which in turn is established by the magnitude of the shunting impedance. For low speed action employed to signal the deposit of a nickel or a dime, the impedance shunting stepping motor S results from the series combination of resistor R12 and diode D3 in parallel with varistor VR1. With the deposit of a quarter, however, break contacts CS operate, as explained above, opening the shunt path around varistor VR2. The higher impedance across stepping motor S, resulting from the addition of varistor VR2 to the combination of varistor VR1, resistor R12 and diode D3, raises the voltage across stepping motor S which increases the stepping and signaling rate. Break and make contacts S1, operated by armature 18 of stepping motor S, interrupt the flow of current to the stepping motor and to oscillator A, respectively, thus providing for the stepping action of the motor and the pulsing action of the oscillator. The function of the components of speed control circuit B is explained in further detail below under the heading OPERATION.

Telephone speech network SN is coupled to ring lead R through switchhook make contact SH2 and inductor L10 and to tip lead T through inductor L12. Speech network SN is wholly conventional and is included herein merely to ensure completeness of disclosure. The upper terminal of transmitter TRA is extended directly to ring lead R and the lower terminal is extended to tip lead T through resistor R21. Receiver REC is similarly bridged between ring lead R and tip lead T through switchhook contact SH1, inductor L14, and capacitor C14. Other

elements in speech network C include dial off-normal contact DON1, resistor R22, capacitor C15, and varistors VR10 and VR11.

The heart of operating control and logic circuit D is the transistor network comprising transistors Q2, Q3A, Q3B, and Q4 which provide switching and logic functions to ensure that each of the operating steps is performed in the proper sequential order and to ensure compatibility with the corresponding central office control circuitry.

Transistor Q4 is a switch that controls current flow in ring lead R. Its base is connected through biasing resistor R16 to the collectors of transistors Q3A and Q3B. The collector of transistor Q4 is connected to ring lead R through biasing resistor R17 and the emitter is connected to the emitter of transistor Q3B, through break contact SH3 or through make contact T1 in series with make contact SH3.

Transistors Q3A and Q3B operate together as a single switch performing two primary functions. When these transistors are ON their combined collector currents which flow in ring lead R are sufficient to operate stepping motor S, provided, of course, that break contact C has not been operated by cam C of coin arm 10 (FIG. 1) and provided further that contacts T2 have transferred. Additionally, current flow in the collector circuits of transistors Q3A and Q3B controls the operation of transistor Q4. When transistors Q3A and Q3B are conducting, transistor Q4 is turned OFF. The combination of transistors Q3A and Q3B is employed in lieu of a single transistor so that sufficient amplification may be obtained with relatively low cost components.

The operation of transistors Q3A and Q3B is in turn controlled by transistor switch Q2. Direct coupling is employed between the collector of transistor Q2 and the base of transistor Q3A. The emitter of transistor Q2 is coupled to the junction formed by the base electrode of transistor Q3B and the emitter electrode of transistor Q3A. With transistor Q2 conducting, transistors Q3A and Q3B are held OFF.

The operating condition of transistor Q2 is controlled by current flowing in tip lead T which results in a voltage drop across reference varistor VR5. This voltage drop is applied to the base of transistor Q2 through a diode gate arrangement which includes diodes D1 and D2 and the direction and magnitude of the drop determines whether transistor Q2 is turned ON or OFF.

Resistors R13, R14, R15, and R19 perform obvious biasing functions. Varistors VR3, VR4, VR7, and VR9 also control the flow of biasing current although their primary function is to provide temperature stabilization.

Coin relay circuit E provides a means for applying ground to telephone speech network C and hence to control and logic circuit D. The grounding path extends through hopper trigger make contact HT1, break contact CR1, coin relay CR and reset electromagnet RE. Resistor R11 is inserted into the line by the operation of coin relay contacts CR1 to limit current flow from the central office when coin relay CR is operated.

A conventional ringer circuit RN including ringer 45 in series with capacitor C16 is bridged across the line between ring lead R and tip lead T.

OPERATION

While the coin telephone is idle, the central office monitors the line by connecting battery between ring lead R and ground with tip lead T left open. When the customer removes the handset (not shown), switchhook contacts SH1 and SH2 operate to energize circuit SN of the telephone set, enabling receiver REC. At the same time switchhook contacts SH3 operate to remove the short from contacts T1. Specifically, the operation of break contact SH3 opens the shorting path across make contact T1.

With the deposit of any coin, shaft 15 and cam T2 of the totalizer (FIG. 1) rotate off normal operating con-

tacts T2 (FIG. 4). Stepping relay S is normally shorted by a conducting path which includes lead 42, break contact T2 and lead 41. With the operation of contact T2, this path is opened at break contact T2 and stepping motor S is readied for operation. At the same time, the operation of make contact T2 completes a shorting path across telephone circuit SN through lead 41.

If the deposit of the first coin does not equal the initial rate, contacts T1 do not transfer. The coin falling into the hopper (not shown) trips hopper trigger make contact HT1 which provides continuity between speech network SN and ground over the path previously described. Consequently, a small current, which may be on the order of 3.5 milliamperes, for example, flows from ground to ring lead R. At this point a voltage drop also appears across reference varistor VR5 in tip lead T. The voltage drop across reference varistor VR5 is applied to the base of transistor Q2 by way of gating diodes D1 and D2, forward-biasing the base-to-emitter junction of transistor Q2. The small current flowing in ring lead R is insufficient to operate the central office line relay (not shown).

With transistor Q2 turned on, bias is applied to transistors Q3A and Q3B in a direction which holds both of these transistors OFF. As a result, stepping motor S which can operate only on current passing through the collectors of transistors Q3A and Q4B remains unoperated.

When the full initial rate is deposited, however, latching rate contact T1 is operated by cam T1 on totalizer shaft 15 and latched in the operated position by means of latching mechanism 22 (FIG. 1). As described above, contacts T1 are thus maintained in the operated position after the totalizer is reset to normal by the stepping mechanism. Normally, dial pulse contacts DP are shorted by a conducting path through varistor VR7, break contact T1, make contact SH3 and varistor VR4. With the operation of break contact T1 this path is opened and dial pulse contact DP is readied for operation. Additionally, the operation of make contact T1 closes an obvious path from ring lead R to ground through transistor Q4 and coin relay circuit E.

With transistors Q3A and Q3B held in the OFF condition by transistor Q3, the base of transistor Q4, being connected to the collectors of transistors Q3A and Q3B through biasing resistor R16, is permitted to rise to a voltage level sufficient to forward bias transistor Q4. With transistor Q4 turned ON, sufficient current flows in ring lead R to operate the central office line relay (not shown) which initiates a conventional sequence of central office switching operations to apply ground to tip conductor T, negative battery to ring lead R and dial tone to the line.

The resulting current flow in tip lead T causes a voltage drop across reference varistor VR5 in a direction to reverse-bias the base emitter junction of transistor Q2. This voltage drop is applied to the base of transistor Q2, as described above, by means of gating diodes D1 and D2 turning transistor Q2 OFF. With transistor Q2 OFF, current through resistor R13 is permitted to flow through the base emitter junctions of transistors Q3A and Q3B and these transistors become conducting. With transistors Q3A and Q3B conducting, transistor Q4 is turned OFF and stepping motor S is permitted to operate through its pulsing break contact S1. With the alternate transfer of make and break contacts S1, pulsed energy is also applied to operate oscillator A as the totalizer is reset to normal.

As indicated above, the slow pulsing rate of stepping motor S, employed to signal nickel and dime deposits, is the result of the stepping motor operating voltage established by the shunting impedance of the parallel circuit comprising varistor VR1, resistor R12 and diode D3. With the deposit of a quarter, break contact CS operates in the manner indicated above, the shunt path around varistor VR3 is opened and the impedance and consequently the voltage across stepping motor S is increased.

With stepping motor S cycling five times for the read out of a deposited quarter, five coin identifying pulses are generated at the high speed rate which may be on the order of 15-18 pulses per second. A corresponding illustrative rate for the low speed pulses is on the order of 5-7 pulses per second.

Varistors VR1 and VR2 have symmetrical bidirectional properties and in one direction the voltage drop across varistor VR1 or across varistors VR1 and VR2 controls the current flowing through stepping motor S and hence the speed at which the stepping motor S operates. When contacts S1 transfer, opening the current path of stepping motor S at break contact S1, current tends to continue to flow through stepping motor S in the same direction. With the supply path open, however, current travels back around through varistor VR1 or through varistors VR1 and VR2 in the opposite direction and it is this current that regulates the release time of the armature of stepping motor S. It is this feature of the invention that permits the pulsing rate to be changed without changing the pulse duty cycle. Stated otherwise, in the high speed condition the armature of stepping motor S operates faster and also releases faster than in the low speed condition so that the signal pulse duty cycle remains substantially constant. In accordance with the principles of the invention a symmetrical varistor combination is employed in lieu of a diode for the reason that although a diode may have the proper voltage drop in the direction that controls stepping motor armature operate time, it would not necessarily have the same resistance in the direction that controls armature release time.

When the totalizer returns to normal, break contact T2, closing, completes the shorting path around stepping motor S, and make contact T2, opening, removes the shorting path across speech network SN. The customer then hears dial tone and may proceed with the call.

Incoming call

When the coin telephone is called from another station, the answering party can trip ringing and talk because the totalizer is left in the normal position after any preceding call. On incoming collect calls, the call may be routed to an operator's position in order to monitor transient coin signals. The operator's position may then apply negative battery to ring lead R with tip lead T grounded, causing the totalizer to be read out immediately following any deposit.

Abandoned call

When a customer abandons a call after having deposited a coin, switchhook break contact SH3 shorts out make contact T1, causing the central office to find ring lead R grounded through resistor R17, the collector-to-emitter path of transistor Q4, make contact T1, make contact SH3, varistor VR4, varistor VR3, resistor R19, dial pulse contacts DP, switchhook make contact SH2, inductor L10, transmitter TRA, and the elements of coin relay circuit E. The central office then applies negative battery to ring lead R and grounds tip lead T, causing transistors Q3A and Q3B to conduct, which permits stepping motor S to reset the totalizer in the manner described above. As soon as contacts T2 return to normal, the central office, finding make contact SH2 open, disconnects and applies coin refund potential. With this type of operation, the central office restores the totalizer to the normal operating condition and refunds any deposit on an incompleting abandoned call regardless of when the deposit was made.

Automatic overtime

After a predetermined time, the initial rate may be collected to operate hopper trigger contact HT1 and notify the customer that an overtime deposit is required. Upon receiving an overtime deposit, the totalizer moves off-normal and is immediately stepped back irrespective of

the value of the initial rate because negative talking battery is present on the line. Shortly thereafter, the central office may check for a ground path through hopper trigger contact HT1 which will of course be closed again if a coin has been deposited.

False ground protection

As previously described, false ground protection is accomplished by shorting out dial pulse contacts DP by means of the shorting path which includes break contact T1. If the customer applies a false ground, the central office will recognize a start signal and bring in dial tone and battery. Nevertheless, dial pulse contacts DP remain shorted, thus preventing a free call. This arrangement is in contrast to certain prior art coin telephone control circuits which employ a second hopper trigger contact on the coin relay as a dial-shortening contact. Such an arrangement provides false ground control for the first nickel deposit only. In accordance with the invention as described, however, false ground protection is achieved without regard to the particular initial rate and without introducing any other possibilities of achieving electrical fraud such as by manipulation of the switchhook, manipulation of the dial pulse contacts or by dropping coins in at particularly select times.

It is to be understood that the embodiment described herein is merely illustrative of the principles of the invention. A wide variety of modifications may be devised by persons skilled in the art without departing from the spirit and scope of the invention.

What is claimed is:

1. In a coin telephone apparatus for generating coin identification signals comprising, in combination, first means responsive to the deposit of a first value coin for generating at least one tone pulse indicative of the value of said first coin, second means responsive to the deposit of a second value coin for generating at least two tone pulses at a first pulse repetition rate, the number of said last named tone pulses and the magnitude of said first pulse repetition rate being separate indications of the value of said second coin, and third means responsive to the deposit of a third value coin for generating at least three tone pulses at a second pulse repetition rate, the number of said last named tone pulses and the magnitude of said second pulse repetition rate being separate indications of the value of said third coin.

2. In a coin telephone, in combination, means for generating an oscillatory signal, a totalizer assembly including a plurality of cams and contacts operatively associated therewith, said totalizer including a shaft in driving relation to said cams, first means responsive to the deposit of a coin in said telephone for rotating said shaft in a first direction through an angle indicative of the value of said coin, second means responsive to the deposit of a coin or coins equal in value to a preselected initial rate and operative after said first means for rotating said shaft in a direction opposite to said first direction through an angle indicative of the value of the coin or coins deposited, means responsive to said second means for alternately applying current to said generating means and to said second means thereby to cause said shaft to rotate in said reverse direction in discrete incremental steps and to cause said generating means to generate a number of tone pulses indicative of the value of deposited coins, and means adjusting the pulse repetition rate of said pulses in accordance with the value of the coin being identified.

3. In a coin telephone, in combination, a totalizer mechanism including a shaft rotatably responsive to the deposit of coins in said telephone, means responsive to the rotation of said shaft through an angle indicative of the deposit of a coin or coins equal in value to a preselected initial rate for reversing the rotation of said shaft and means responsive to said reversing means for generating tone pulse coin identification signals indica-

tive in terms of number and in terms of pulse repetition rate of the value of deposited coins.

4. In a coin telephone, in combination, means for storing information indicative of the value of coins deposited in said telephone, means responsive to the deposit of coins equal in value to a preselected initial rate for reading out said information, and means responsive to said read out means for generating transmission tone pulse signals indicative in terms of number and in terms of pulse repetition rate of the value of deposited coins.

5. In a coin operated telephone including dial pulse generating means and a speech network bridged across ring and tip leads, control apparatus comprising, in combination, a totalizer mechanism having a shaft rotatably responsive to the deposit of coins in said telephone, a plurality of cams mounted on said shaft, a plurality of sets of electrical contacts each set being operatively associated with a respective one of said cams, a first conducting path across said ring and tip leads normally shorting said speech network, a second conducting path normally shorting said dial pulse generating means, means including a first one of said cams and its associated contacts responsive to the rotation of said shaft from a normal or index position for opening said first conducting path, means including a second one of said cams and its associated contacts responsive to the deposit of coins equal in value to a preselected initial rate for rotating said shaft in discrete incremental steps back to said normal position and for opening said second conducting path, the angular magnitude of each of said steps being indicative of the value of a minimum coin deposit, means for generating an oscillatory signal, means including a third one of said cams and its associated contacts for controlling the speed of said rotating means in accordance with the value of deposited coins, and means responsive to the operation of said rotating means for applying direct current pulses to said oscillator whereupon said oscillator generates coin identification signals in the form of tone pulses indicative of the value of deposited coins in terms of the number of said tone pulses and in terms of the repetition rate of said tone pulses.

6. Apparatus in accordance with claim 5 wherein said rotating means further includes a stepping motor having an armature, mechanical means for translating the movement of said armature into rotational movement of said shaft, means including a transistor switch for applying operating current to said motor and to said generating means, means including a control transistor for establishing the operating bias of said transistor switch, means responsive to the flow of current in said tip lead for establishing a voltage drop, and means for applying said voltage drop to said control transistor thereby to enable said control transistor to bias said transistor switch in the ON condition whereupon operating current is applied to said stepping motor.

7. Apparatus in accordance with claim 6 wherein said voltage drop establishing means comprises a varistor in series relation with said tip lead.

8. Apparatus in accordance with claim 6 including a first set of contacts responsive to each operation of said armature for opening the current supply path to said motor, thereby rendering said motor self-stepping, and a second set of contacts responsive to each operation of said armature for opening the current supply path to said generating means thereby to produce a tone pulse output from said generating means.

9. Apparatus in accordance with claim 6 including a third conducting path with at least one impedance element therein shunting said stepping motor and establishing thereby the operating potential and operating speed of said stepping motor, and means including a third one of said cams and its associated contacts responsive to the deposit of a quarter for adding an additional impedance element to said third conducting path thereby to increase

the speed of said motor and to increase the output pulse repetition rate of said generating means.

10. Apparatus in accordance with claim 9 wherein said third conducting path includes a diode and a first varistor in parallel circuit relation and wherein said additional impedance element comprises a second varistor in series relation with said parallel circuit, said third conducting path further including a normally closed shunt path around said second varistor, said shunt path being opened by the operation of said last named associated contacts.

11. A coin operated telephone comprising, in combination, totalizer apparatus including first, second and third cams driven by a totalizer shaft, first, second and third sets of contacts each operatively associated with a respective one of said cams, said telephone including dial pulse generating means and a speech network, first means responsive to the deposit of a coin for rotating said shaft from a normal or index position through an angle indicative of the value of the deposited coin, second means for rotating said shaft in discrete incremental steps back to said normal position of said shaft, each of said steps corresponding in magnitude to the value of a minimum coin deposit, means including a fourth cam mounted for free rotation on said shaft responsive to the deposit of a coin for momentarily disabling said second rotating means thereby to preclude the simultaneous application of opposing rotational forces to said shaft by said first and second means, means including said first cam and said first contacts responsive to the rotation of said shaft to an off-normal position for enabling said second rotating means and for shorting out said speech network, means including said second cam and said second contacts responsive to the rotation of said shaft through an angle indicative of the deposit of coins equal in value to a preselected initial rate for unshorting said dial pulse generating means, means responsive to the operation of said second rotating means for generating tone pulse signals indicative of each deposited coin in terms of the number of said pulses, means including said third cam and said third contacts responsive to the operation of said second means in rotating said shaft through an angle indicative of the deposit of a coin of a particular preselected value for increasing the repetition rate of said tone pulses, thereby to generate a coin identifying signal for each coin value distinguishable both in terms of the number of pulses and in terms of the repetition rate of said pulses, and means for ensuring a fixed coin identifying signal pulse duty factor irrespective of repetition rate.

12. Apparatus in accordance with claim 11 wherein said shaft includes a recessed keyway portion and wherein said third cam includes an internal key mounted for engaging relation with said keyway, said keyway being substantially larger than said key whereby said third cam is permitted to rotate freely on said shaft through an arc of predetermined size, bearing against but not operating said third contacts until said shaft has been rotated through said arc in response to the deposit of a coin equal in value to said particular preselected value.

13. Apparatus in accordance with claim 11 wherein said shaft rotating means includes a motor in driving relation to an armature, means for translating movement of said armature into rotational movement of said shaft and fifth and sixth sets of contacts responsive to movement of said armature, said fifth contacts interrupting the supply of current to said motor, thereby enabling said motor and said armature to operate in stepping fashion, and said switch contacts interrupting the supply of current to said tone pulse generating means.

14. Coin operated telephone control apparatus compatible with a central office negative polarity start signal comprising, in combination, a totalizer including a shaft and a plurality of sets of contacts each operated by a respective cam mounted on said shaft, first means respon-

sive to the deposit of a coin in said telephone for rotating said shaft in a forward direction through an angle indicative of the value of said coin, second means including a first one of said sets of contacts responsive to the rotation of said shaft in said forward direction through an angle indicative of the deposit of a coin or coins equal in value to a preselected initial rate for rotating said shaft in a reverse direction in discrete incremental steps back to a normal or index position, the magnitude of each of said steps being indicative of a minimum coin deposit, means responsive to said second means for generating tone pulse coin identification signals indicative of the value of deposited coins both in terms of the number of pulses and in terms of the repetition rate of said pulses, the duty cycle of said pulses remaining constant irrespective of said repetition rate, said telephone including a speech network and dial pulse signal generating means, means including a first set of said contacts responsive to the rotation of said shaft from its normal position by the deposit of a coin for enabling said second means, means including a second set of said contacts responsive to the rotation of said shaft by a coin or coins equal in value to a preselected initial rate for enabling said dial pulse signal generating means, means including a third set of said contacts responsive to the rotation of said shaft by a coin having a preselected value for increasing the repetition rate of said tone pulses, and means including a fourth set of said contacts responsive to the rotation of a corresponding one of said cams by the deposit of a coin for momentarily disabling said second means thereby to preclude the application of opposing rotational forces to said shaft.

15. In a coin operated telephone control apparatus compatible with a central office negative polarity start signal comprising, in combination, a totalizer mechanism including a shaft and a plurality of cams mounted thereon, first means responsive to the deposit of a coin for rotating said shaft through an angle indicative of the value of said coin, control circuitry including a ring lead, and a tip lead, the speech network of said telephone being connected across said leads, second means including a motor and an armature for rotating said shaft in a reverse direction in discrete incremental steps, the magnitude of each of said steps being indicative of a minimum deposit coin, thereby to read out the coin deposit information stored by the rotation of said shaft by said first rotating means, said motor being in series relation with said ring lead, a first conducting path shunting said motor, means including contacts operatively responsive to a first one of said cams upon the rotation of said shaft in response to the deposit of a coin for opening said first path thereby to enable said motor, means including first impedance means for controlling the speed of said motor, said impedance means being in parallel circuit relation with said motor, an oscillator circuit in parallel relation with said motor for generating coin identification signals, means including contacts operated by said armature for alternately opening said ring lead and said oscillator circuit whereby said armature is caused to operate in stepping fashion and said oscillator is caused to operate in pulsing fashion, transistor switch means for controlling supply current to said motor, second impedance means in series with said tip lead responsive to current flow in said tip lead for establishing a control potential, means including a first transistor for applying biasing potential to said transistor switch means, means including a diode gate for applying said control potential to said last named transistor thereby to control the conducting state of said last named transistor and of said transistor switch means, and means including a switch operatively responsive to the deposit of a coin of preselected value for increasing the impedance magnitude of said first impedance means thereby to increase the speed of said motor whereupon the pulsing speed of

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said oscillator is increased without changing the pulse duty cycle.

16. Apparatus in accordance with claim 15 including a second transistor having base, emitter and collector electrodes, means for controlling current flow in said ring lead including a second conducting path between said ring lead and ground potential, said second conducting path including the collector to emitter path of said second transistor, means for applying current flow through said transistor switch to said base electrode of said second transistor thereby to turn said second tran-

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sistor OFF whereupon current flow in said ring lead is caused to flow through said motor.

References Cited by the Examiner

UNITED STATES PATENTS

2,819,343	1/1958	Faulkner	179—6.3
2,883,463	4/1959	Goodale et al.	179—6.3
3,086,081	4/1963	Cath et al.	179—6.3

ROBERT H. ROSE, Primary Examiner.