

Feb. 18, 1969

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3,428,751

COIN TELEPHONE, ANTIFRAUD CIRCUIT

Filed Jan. 28, 1966

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FIG. 1

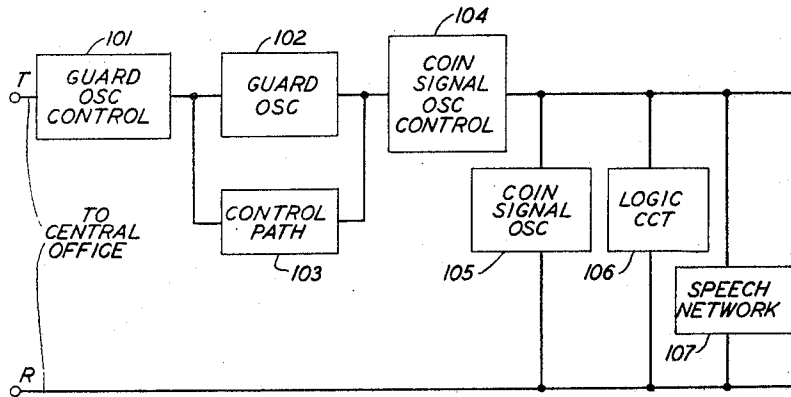
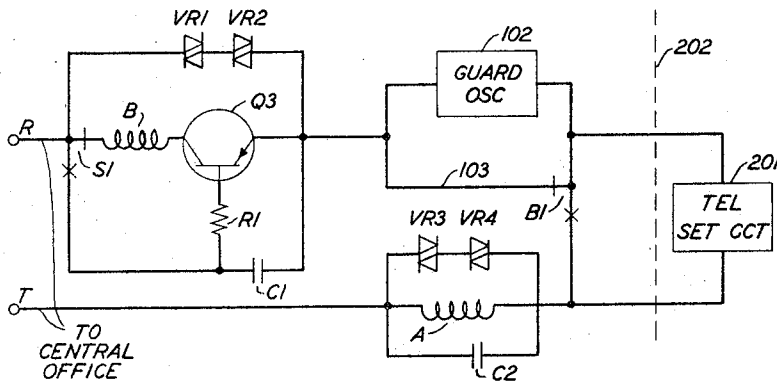


FIG. 2



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FIG. 3

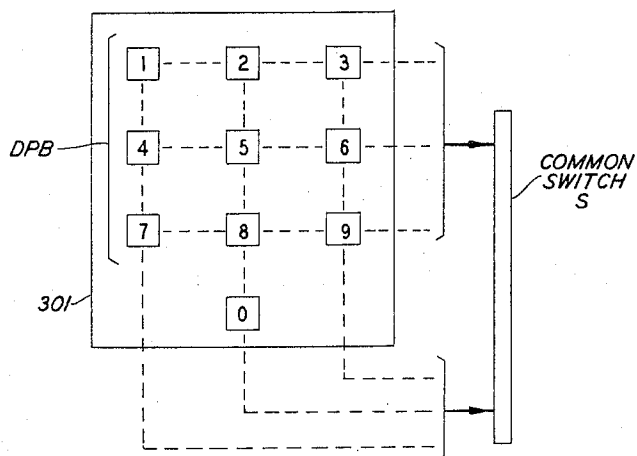
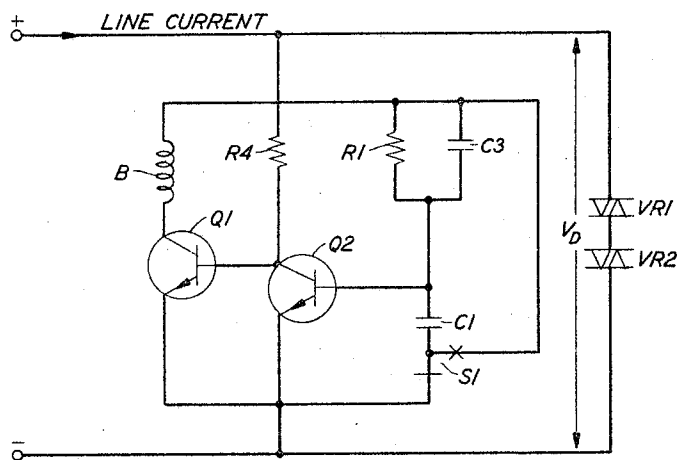


FIG. 4



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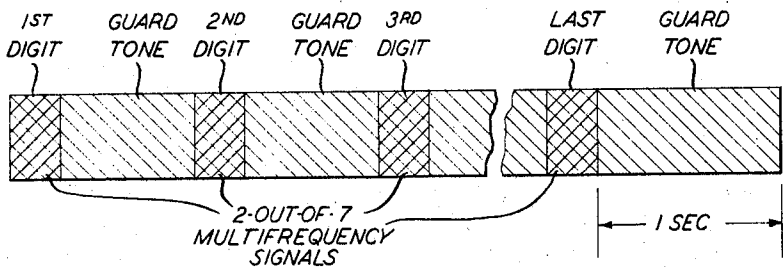
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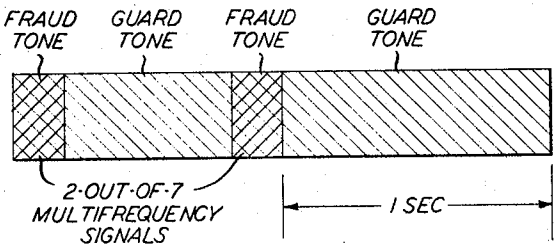
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FIG. 5A



NORMAL TOUCH-TONE DIALING SIGNAL OUTPUT

FIG. 5B



FRAUDULENT ATTEMPTED SIMULATION OF 10¢
DEPOSIT BY TOUCH-TONE SIGNALS

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COIN TELEPHONE ANTIFRAUD CIRCUIT

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10 Claims

Int. Cl. H04m 17/02

ABSTRACT OF THE DISCLOSURE

This invention relates to coin operated telephones using voice-frequency tones for dialing and for indicating the value of coins inserted. Fraudulent or accidental misregistering of dial frequencies as deposit frequencies is prevented by following each dial frequency with a measured burst of a specified guard frequency, thereby identifying all dial-originated frequencies.

This invention relates to coin operated telephones and more specifically to coin telephones employing dial generated multifrequency signaling.

An essential feature of any coin operated telephone is a means responsive to the deposit of a coin for generating signals indicative of the value of the deposit. The most common coin deposit signaling means is an arrangement wherein each deposited coin strikes a distinctive gong or chime. The sound generated thereby is converted to an electrical signal by means of a transducer which signal is then applied to the line. The corresponding sounds heard by the operator are readily interpreted as representative of the particular coin deposited.

A more recent development in the field of coin deposit signaling employs a switching device that operates one or more times in response to the deposit of each coin, each switch operation being indicative of an increment of coin value, such as five cents, for example. Each operation of the switch energizes an oscillator that generates an oscillatory, electrical signal burst in the audio frequency range that is then applied to the line. The corresponding audio tone pulses are counted by the operator to determine the value of the coins deposited. A system of this type is disclosed by E. R. Andregg and L. A. Strommen in Patent 3,146,312 issued Aug. 25, 1964.

When either of the above-described coin identification signal systems is used in a telephone employing a multifrequency signal generating dial, one form of which is termed a Touch-Tone dial, a possibility of confusion arises in distinguishing the dial signals from the coin signals. In the Touch-Tone dial, for example, the simultaneous operation of certain combinations of dial pushbuttons results in the generation of a single frequency tone which can be mistaken by an operator for the single frequency tone generated by a coin identification signal oscillator, despite a substantial frequency separation between the two signals. Additionally, some operators find difficulty in distinguishing between the multifrequency tone that results from the operation of a single dial-pushbutton and a single frequency coin signal. In some instances other operators are unable to distinguish between Touch-Tone signals, either single frequency or multifrequency, and the broad spectrum chime and gong coin deposit signals. Whether the simulation of coin deposit signals occurs through accidental or fraudulent manipulation of the pushbuttons of a multifrequency type dial, the same undesirable result occurs—providing telephone service without charge.

Accordingly, an object of the invention is to reduce the possibility of confusion between multifrequency dial signals and electrically generated coin signals in coin operated telephones.

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Another object is to reduce the possibility of confusion between multifrequency dial signals and mechanically generated coin signals in coin operated telephones.

A further object is to reduce the incidence of fraud in the use of coin operated telephones.

These and other objects are achieved in accordance with the principles of the invention in one illustrative embodiment wherein a coin operated telephone is provided with a guard tone oscillator responsive only to the release from an operated condition of any of the pushbuttons of an otherwise conventional Touch-Tone dial to the end that each normally generated multifrequency dial-generated pulse is followed immediately by a distinctive single frequency guard tone, thereby eliminating any possible confusion between dial signals and coin deposit signals. In order to avoid any possible interference with the normal operation of the central office multifrequency receiving equipment, the invention provides for the automatic removal of the guard tone whenever the dial is actuated at the time that the guard tone is present.

In accordance with one aspect of the invention, means are provided for preventing the customer from hearing the guard tone thus deterring him from interfering with guard tone generation and further, preventing any tendency the customer might otherwise have to reduce his normal dialing rate as the result of delaying the operation of each dial pushbutton while awaiting the termination of the guard tone signal.

In order further to mark the guard tone with unmistakable characteristics, tone duration is employed as a distinctive quality inasmuch as differences in frequency and amplitude are more difficult for the average operator to detect. Specifically, guard tone duration is on the order of one full second provided that the tone is not terminated earlier by the operation of an additional dial-pushbutton.

Accordingly, one feature of the invention involves the generation of a guard tone dial identifying signal following the generation of each multifrequency dial pulse by the dial of a coin operated telephone.

Another feature relates to the shorting out of the receiver during guard tone generation in order to prevent the customer from hearing the guard tone.

A further feature pertains to an arrangement for isolating the guard tone oscillator from variations in loop impedance.

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

FIG. 1 is a block diagram of the circuitry of a coin operated telephone in accordance with the principles of the invention;

FIG. 2 is a schematic circuit diagram of a portion of the circuitry shown in block form in FIG. 1;

FIG. 3 is a sketch of a multifrequency signal generating pushbutton operated dial of the type used in a coin operated telephone set in accordance with the invention;

FIG. 4 is a schematic circuit diagram of the guard oscillator control circuit shown in block form in FIG. 1 and is a modified version of that circuit as shown in FIG. 2;

FIG. 5A is a sketch of the type of signal train developed by a coin telephone in accordance with the invention during a normal dialing sequence; and

FIG. 5B is a sketch of the type of signal train developed by a coin telephone in accordance with the invention during a fraudulent attempt to simulate a coin deposit signal representing a 10 cent deposit.

FIG. 1 indicates the general functional relationship between the elements required in a coin telephone set in accordance with the invention and the elements of a

conventional set. The conventional subscriber's loop includes tip lead T and ring lead R. A guard signal oscillator circuit 102 is in series relation with tip lead T and may be shunted by a control path 103 under the supervision of a guard oscillator control circuit 101. Guard oscillator control circuit 101 is also in series with tip lead T. The remaining elements or circuit blocks shown in FIG. 1 are conventional and include a coin signal oscillator control circuit 104, a coin signal oscillator 105, logic circuitry 106 for controlling the overall sequencing of the telephone operation and the speech network 107. Each of these last named circuit blocks may take any one of a number of prior art forms including, for example, the circuitry shown in Patent 3,146,312 issued to E. R. Andregg and L. A. Strommen on Aug. 25, 1964 or in application Ser. No. 454,889 filed by A. Busala, R. R. Stokes and L. A. Strommen on May 11, 1965.

Details of the guard oscillator control circuit 101 and its associated control path 103 are shown in FIG. 2. In FIG. 2 prior art elements such as those shown in FIG. 1 are lumped together in a single block 201 labeled telephone set circuitry, shown to the right of dotted line 202. In order further to clarify the relationship between the circuitry of a coin telephone set that embodies the features of the invention and prior art circuit arrangements, the conventional line current detecting relay A, its associated shunting varistors VR3 and VR4 and the shunting capacitor C2 are also shown in detail.

In accordance with the invention, the guard oscillator control circuit 101 includes a relay coil B in the collector circuit of a control transistor Q3. Varistors VR1 and VR2 provide an A-C shunting path around guard oscillator control circuit 101, serving to isolate this circuit from variations in loop impedance. The operation of transistor Q3 is in turn controlled by a timing circuit comprising resistor R1 and capacitor C1. Transfer contacts S1 are operated by a common switch S, shown in FIG. 3, which in turn is operatively responsive to the depression of any one of the pushbutton DPB of the pushbutton dial assembly 301. Details of an illustrative dial assembly of the type shown in FIG. 3 are disclosed, for example, in Patent 3,109,071 issued to C. E. Mitchell et al. on Oct. 29, 1963.

The detailed operation of the circuit shown in FIG. 2 is as follows. Depression of any one of the pushbuttons DPB of dial 301 operates switch S and the associated make and brake contacts S1 in the manner shown. Brake contact S1 prevents relay B from operating. As a result, no identifying tone is produced during the time that conventional multifrequency dial signals are present. A charging path for capacitor C1 is maintained during this period by way of make contact S1 and capacitor C1 is charged by the current on the line. The release of the operated one of the pushbuttons DPB allows switch S1 to return to its normal or nonoperated position and the operating path for relay B is thereby completed over nonoperated break contact S1. Relay B operates and is held operated by current in the emitter-collector path of transistor Q3. The current in relay B is in effect controlled by the decaying base current of transistor Q3. Stated otherwise, the time during which relay B remains operated is controlled by the time constant introduced by resistor R1 and capacitor C1 in the base circuit of transistor Q3.

The operation of relay B operates transfer contacts B1 thus opening the control path 103 that otherwise shorts the guard oscillator circuit 102. The operation of make contact B1 places a short across telephone circuit 201. Consequently, tone from the guard oscillator 102 is applied to the line but not to the speech network, and as a result, the customer is not aware that a guard tone is being generated. This feature of the invention deters a customer from interfering with the generation of guard tone by oscillator 102, inasmuch as the customer is unaware that such tone is being generated, and further, it avoids the otherwise likely effect of reducing dialing speed as the customer, if the guard tone were audible, would be in-

clined to wait after the dialing of each digit until the termination of the guard tone before dialing the next succeeding digit.

The dialing of successive digits by dial 301 in a telephone set in accordance with the invention results in a train of signals such as that illustrated in FIG. 5A. An attempt to simulate a coin deposit signal representing a 10 cent deposit by fraudulent manipulation of the dial results in a train of signals such as that illustrated in FIG. 5B.

The guard oscillator 102 may take any one of a number of forms such as that of a conventional transistor oscillator for example. The frequency of oscillator 102 may be selected, advantageously in accordance with the invention, to provide maximum separation from the frequency range of the conventionally generated multifrequency dial signals and, preferably, the guard signals should be in a frequency range outside the effective range of the associated central office multifrequency receiver.

Under certain conditions the guard oscillator control circuit 101, shown in detail in FIG. 2, is somewhat sensitive to changes in temperature and variations in transistor parameters. Some improvement in these areas is achieved by a modified guard oscillator control circuit of the type shown in FIG. 4. Circuit elements in FIG. 4 corresponding to circuit elements in FIG. 2 are similarly identified.

As indicated above, in the circuit shown in FIG. 2 a single transistor Q3 is employed to control current in relay B and the operate time of relay B is dependent on the transistor current falling below the release current level of the relay. Consequently, a circuit such as that shown in FIG. 2 is dependent for its operation on the β or amplification of the transistor. The circuit shown in FIG. 4 employs a somewhat different principle of operation, however, in that the operate time of relay B is controlled primarily by a transistor in a cut-off state. The time of switching is determined by the time of turn-off of the transistor which is, in turn, the time that the base to emitter voltage increases to a value great enough to forward bias the base to emitter junction. An advantage obviously stems from the fact that the percentage change in voltage with variations in temperature and transistor parameters is small when compared to the percentage change in transistor gain.

A further understanding of the principles of the circuit shown in FIG. 4 may be gained from following a detailed description of overall circuit operation. In the static state, with the coin telephone set in use but with no dial button depressed, transistor Q2 is saturated with transistor Q1 off. Voltage V_D is maintained relatively constant over the entire range of line currents owing to the characteristics of varistors VR1 and VR2. Capacitor C1 is charged to a voltage level that is substantially equal to the emitter to base voltage of the saturated transistor Q2.

When switch S1 is transferred to the off-normal position, which occurs as described above when one of the dial pushbuttons DPB (FIG. 3) is depressed, capacitor C1 charges through the saturated base junction of transistor Q2 and is placed in parallel with resistor R1 and capacitor C3. Capacitor C1 thus charges to a voltage level approximately equal to $-V_D$. Inasmuch as transistor Q2 was already in a saturated state, there is no change in the conducting state of transistors Q1 or Q2 and no output from the circuit is produced. As soon as switch S1 returns to its normal position upon the release of a dial pushbutton, the voltage across capacitor C1 is a negative voltage and reverse biases the base junction of transistor Q2, allowing the transistor Q2 collector to emitter voltage to increase to a value that saturates transistor Q1. The voltage across capacitor C1 increases from a level approximately equal to $-V_D$ toward a value of $+V_D$ at an exponential rate controlled by the time constant of resistor R1 and capacitor C1. The charge current for this portion of the operation may be on the order of 40 microamps and would be affected by any leakage cur-

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rent, I_{co} , of the transistor. It is desirable therefore to employ a silicon transistor with a very low I_{co} . Transistor Q2 again turns on when the voltage across capacitor C1 becomes great enough to forward bias transistor Q2. Capacitor C3 is used to ensure that the circuit will not trigger when the line current is momentarily interrupted.

It is to be understood that the embodiments described herein are merely illustrative of the principles of the invention. Various modifications may be made thereto by persons skilled in the art without departing from the spirit and scope of the invention.

What is claimed is:

1. In a coin operated telephone, in combination, a plurality of digit indicating means, means responsive to the operation of any one of said indicating means for generating a dial signal indicative of a corresponding digit in terms of frequency composition, and means responsive to the release of any one of said indicating means from an operated condition for generating a guard signal of a common frequency composition, said last named frequency composition being substantially different from and readily distinguishable from any one of said frequency compositions corresponding to said digits, thereby reducing the possibility of confusion between dial generated signals and coin identification signals.

2. Apparatus in accordance with claim 1 wherein said digit indicating means comprises a pushbutton type telephone dial.

3. Apparatus in accordance with claim 1 wherein said guard signal generating means comprises a single oscillator.

4. In a coin operated telephone, in combination, an array of digit indicating dial pushbuttons, first means responsive to the depression of each of said pushbuttons for generating a multifrequency signal indicative of a corresponding digit in terms of a frequency code, and means responsive to the release of any one of said pushbuttons from a depressed condition for generating a common single frequency guard signal immediately following the signal generated by said first means, thereby reducing the possibility of confusion between signals generated by said first means and coin identification signals.

5. A coin operated telephone circuit comprising, in combination, an array of digit indicating dial pushbuttons, means responsive to the depression of each of said pushbuttons for generating a multifrequency signal indicative of a corresponding digit in terms of a frequency code, an oscillator, common switch means operatively responsive to the release of any one of said pushbuttons for energizing said oscillator thereby to cause the generation of a common single frequency guard signal immediately following the generation of any one of said multifrequency signals, whereby the possibility of confusion between signals generated by said dial and signals generated by the deposit of coins is substantially reduced.

6. Apparatus in accordance with claim 5, including a subscriber's loop, a relay in series with one side of said loop, a timing circuit in series with said relay, an oscillator in series with said relay, said switch means including a first switch responsive to the depression of any one of said pushbuttons for completing a first shunt path

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around said relay, said relay including contacts operatively responsive to said relay for completing a second shunt path around said oscillator, and said first switch opening said first shunt path upon the release of any one of said pushbuttons from an operated condition, whereupon said relay operates, opening said second shunt path and applying said guard signal across said loop.

7. Apparatus in accordance with claim 6 wherein said timing circuit includes a transistor switch having base, emitter and collector electrodes, the collector-emitter path of said transistor being in series with said relay, a resistive element connected between the base of said transistor and said first shunt path, and a capacitive element in said first shunt path.

8. Apparatus in accordance with claim 7 including at least one varistor in a shunt path across both said relay and said transistor.

9. A coin operated telephone circuit comprising, in combination, a pushbutton dial assembly including means responsive to the depression of each digit designating pushbutton for generating a multifrequency signal burst indicative of the corresponding digit in terms of a frequency code, a subscriber's loop, an oscillator in series relation with one side of said loop, circuit means connected across said loop responsive to the release of one of said pushbuttons from a depressed condition for energizing said oscillator for a preselected period, whereupon a single frequency guard signal of preselected duration is applied to said loop following the generation of each of said multifrequency signals, said circuit means including means responsive to the depression of one of said pushbuttons for terminating the generation of one of said guard signals prior to the end of said duration, thereby preventing the simultaneous generation of one of said multifrequency signals and one of said guard signals, thereby reducing the possibility of confusion between signals generated by said dial assembly and coin deposit identification signals.

10. Apparatus in accordance with claim 9 wherein said circuit means includes a relay having a coil bridged across said loop, first and second capacitive elements in parallel with said coil, a resistive element shunting one of said capacitive elements, a first transistor switch having base, emitter and collector electrodes with its collector to emitter path in series relation with said coil, a conductive path including a resistive element bridged across said loop in parallel relation with said coil and in parallel relation with said capacitive elements, a second transistor switch having base, emitter and collector electrodes with its collector to emitter path in series relation with said conductive path and means connecting said base electrode of said first transistor to said collector electrode of said second transistor.

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UNITED STATES PATENTS

3,069,502 12/1962 Edström et al. ----- 179-6.3

WILLIAM C. COOPER, *Primary Examiner*.

J. S. BLACK, *Assistant Examiner*.