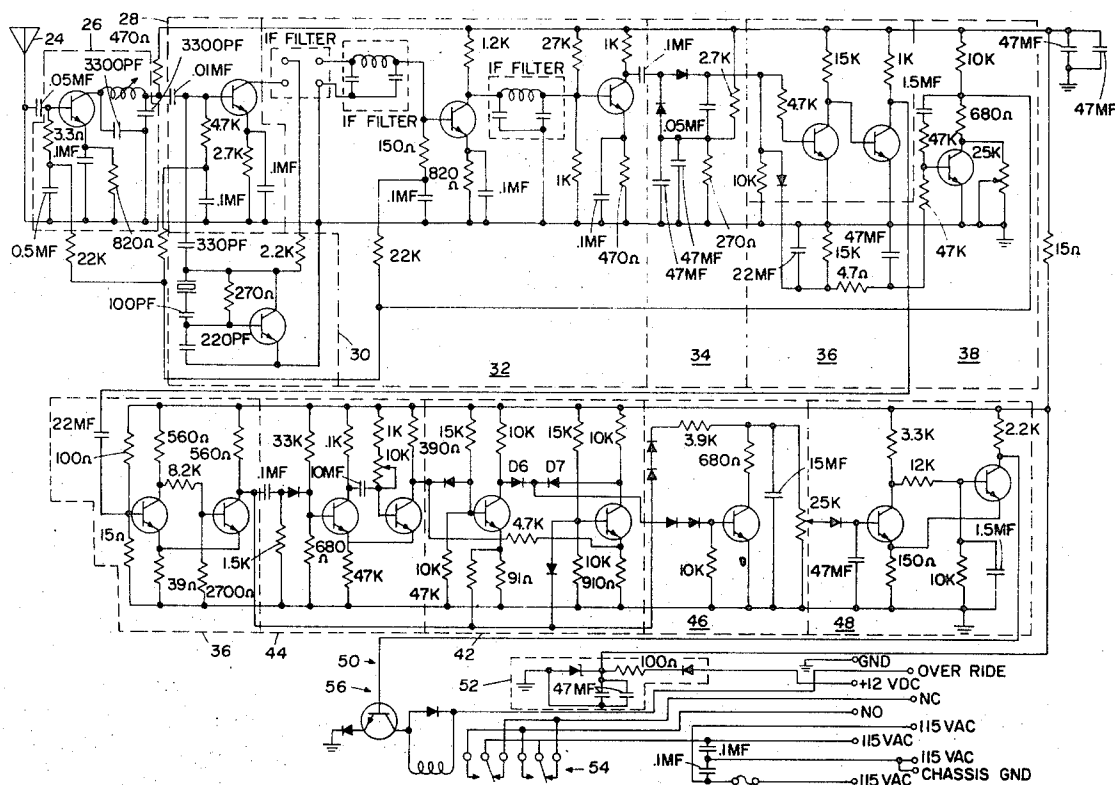




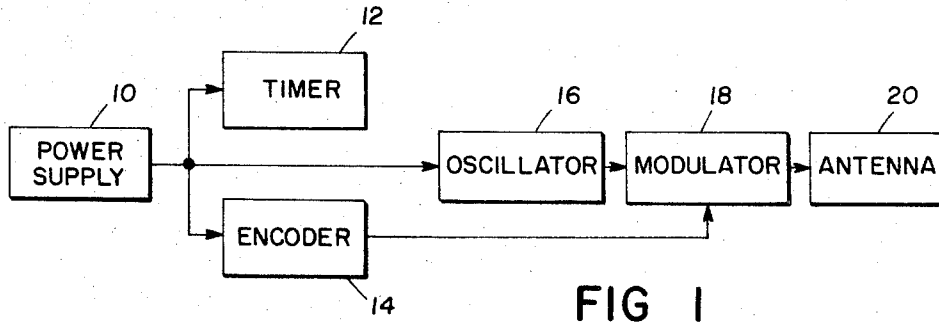


FIG 1

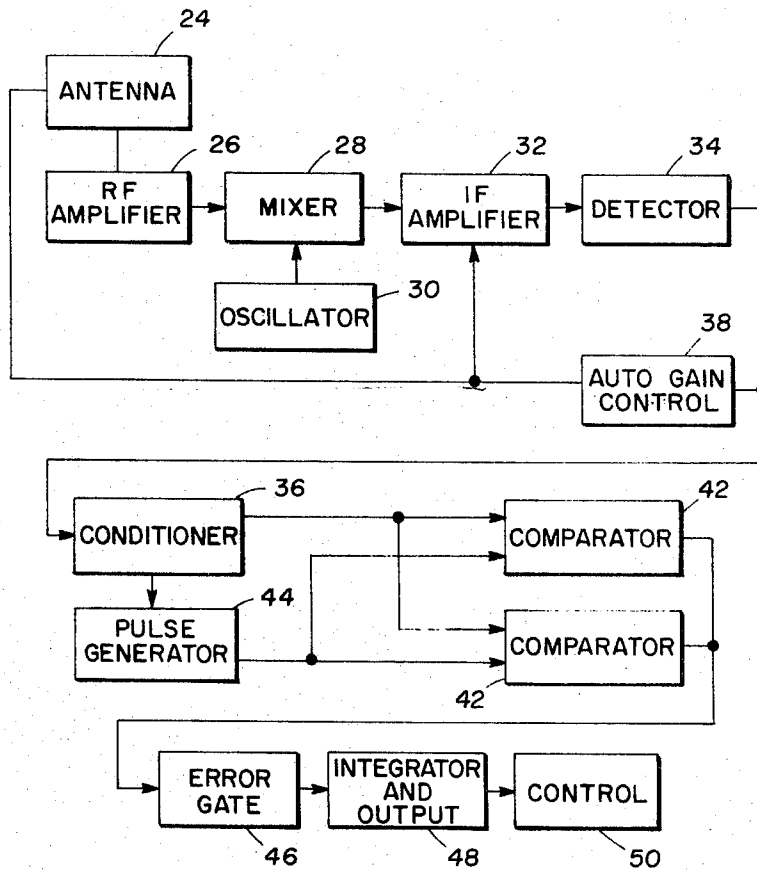
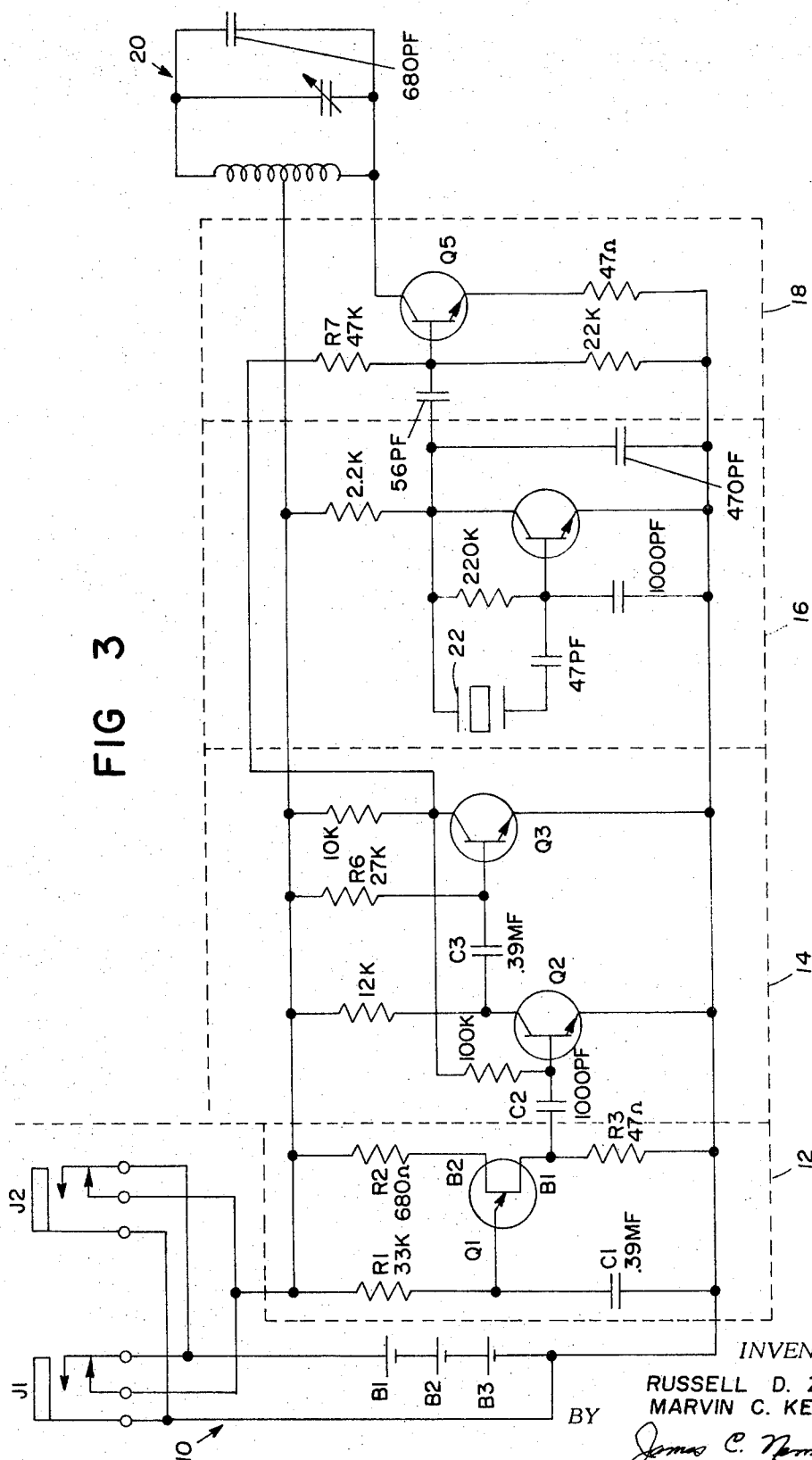


FIG 2

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FIG 3

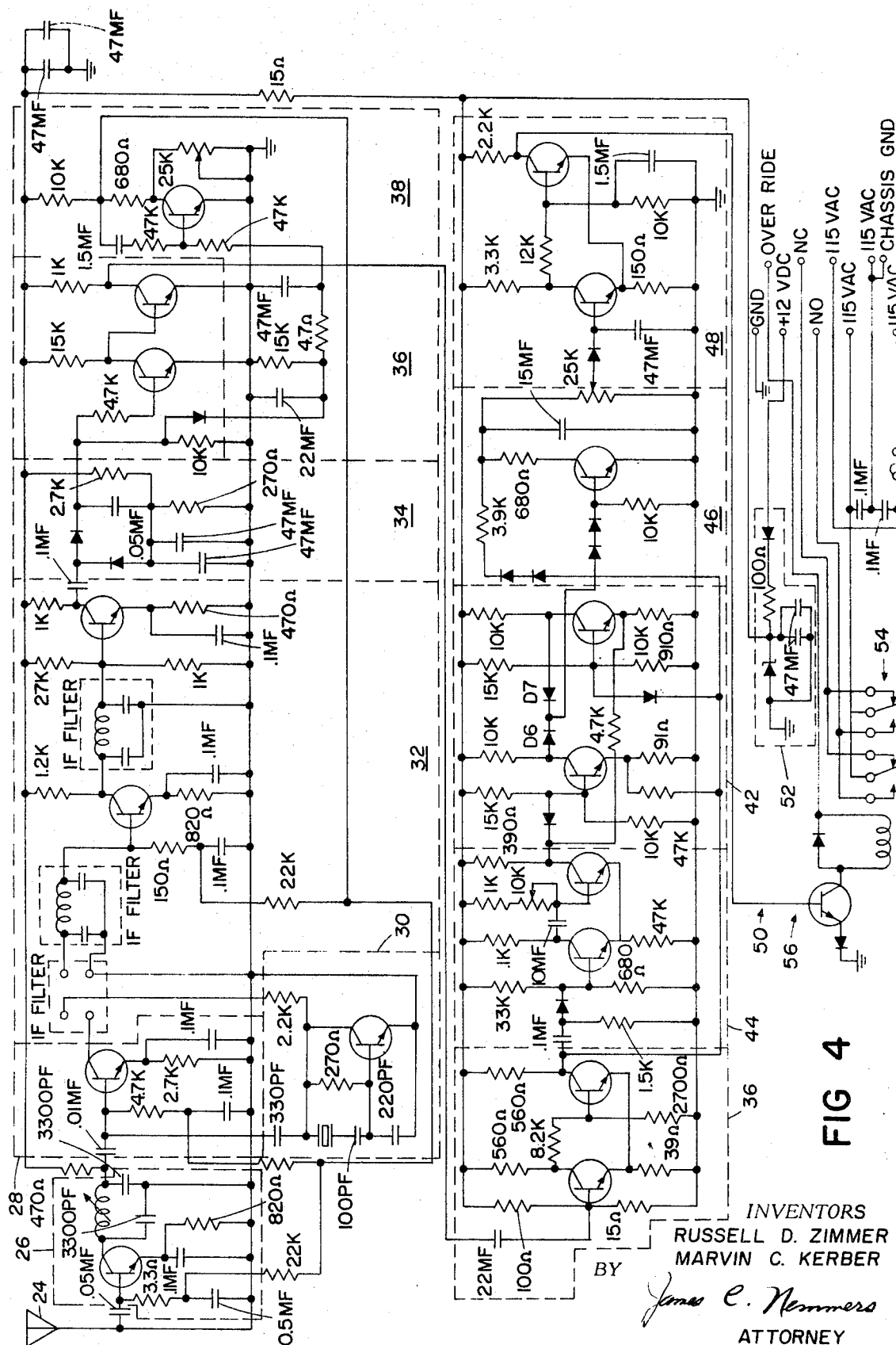


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REMOTE CONTROL SYSTEM FOR LOCKING DEVICE

BACKGROUND OF THE INVENTION

There are known in the art many remote control systems in which a device can be actuated by a signal transmitted from a remote location. One of the simplest and most commonly known systems is the remote control of the operation of garage doors. However, there are many other systems and uses for the remote actuation of devices, some of these other known systems being of a rather sophisticated nature. Many of the prior art systems, in order to avoid interfering signals which bring about unwanted actuation, use receivers that will produce an actuating output only if the signal received is a certain combination of frequencies or a combination of a certain frequency and pulses, and other various combinations. The prior art systems using combinations of different frequencies have the disadvantage that the number of combinations are limited and also the circuits can be more easily triggered by someone inclined to do so. Also, the use of a combination of different frequencies involves duplication of the transmitter circuitry and receiver circuitry thus increasing the cost of such systems. Some remote control systems use tone control, but these involve the use of bulky inductors. Particularly, in applications where remote control of a locking or other security device is involved, it is highly desirable to have a receiver which will produce actuation of the locking device only upon receipt of a signal which is not easily duplicated either accidentally or intentionally. In such applications as remote control actuation of vehicle door locks, teller cash drawer locks in banks, etc. it is necessary that actuation of the locking device be triggered only if a signal is received containing a particular combination of parameters at any given instant. This greatly minimizes the possibility of intentional triggering of the locking device by unauthorized individuals.

Also, because it is not infrequent that individuals forget to lock or unlock their vehicles, cash drawers, etc. it is further desirable to provide a remote control system which is fully automatic so that if the authorized individual leaves his vehicle or cash drawer unattended, the locking device will be automatically actuated. The prior art does disclose some uses and applications of the near radiation field, but generally, the near field is considered undesirable and is avoided because of the limited range in which the signal is effective. Thus, the prior art does not disclose any system intentionally using the near radiation field to produce automatic actuation of an electro-mechanical device such as a locking device, in a situation where accurate short range control is desirable and obtainable only with the near field.

SUMMARY OF THE INVENTION

The remoted control system of the invention intentionally utilizes the near radiation field and thereby provides for automatic actuation of an electro-mechanical device, such as a lock. This is accomplished by providing a receiver at the location of the locking device, the output of the receiver being utilized to actuate the device. A portable transmitter is carried on the person of the operator, and the transmitter, when on, will continuously produce pulse-coded signals at a predetermined frequency. The receiver circuitry is de-

signed to receive and decode the pulse-coded signal from the transmitter and cause the desired actuation. The transmitter will produce an output signal of appreciable strength only in the near radiation field, the strength of which decreases inversely as the cube of the distance from the transmitter antenna. Thus, physical presence of the transmitter on the person of the operator within the limits of the near field established is necessary to cause actuation of the locking device. Also, removal or absence of the transmitter from the near field will produce no signal and thus no actuation of the device. Depending on the application in which the system of the invention is used, the presence of the transmitter within the limits of the near field can cause the unlocking of a cash drawer, a vehicle door lock, etc., whereas removal of the transmitter from the limits of the near field will cause the device to once again automatically lock. The transmitter circuitry is designed to produce coded pulses, and by selecting a particular pulse width and repetition rate of the pulses as well as a specific frequency, it will be extremely difficult for unauthorized personnel to produce the necessary combination to cause actuation. By using and varying the three parameters of frequency, pulse width and pulse repetition rate, thousands of different combinations are available so that inadvertent or intentional duplication of a specific transmitter-receiver system is greatly minimized. Thus, the possibility is extremely remote that a particular transmitter will produce the signal necessary to cause actuation of some locking device other than the one intended. Therefore the system can be used in any number of locking applications since different "electronic keys" can be produced by utilizing the principles of the invention. Moreover, by utilizing the near radiation field, automatic actuation is assured whenever the system is powered, and since very low power is required the transmitter and receiver can be designed using semi-conductor components which are battery powered. A very compact transmitter can thus be produced which can easily be carried on the person and the receiver can be easily designed into the locking device.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a block diagram of the transmitter unit of the invention;

FIG. 2 is a block diagram of the receiver unit of the invention;

FIG. 3 is a detailed schematic diagram of the circuitry for a transmitter constructed according to the principles of the invention; and

FIG. 4 is a detailed schematic diagram of the circuitry of a receiver unit constructed according to the principles of the invention.

DESCRIPTION OF THE PREFERRED EMBODIMENT OF THE INVENTION

In FIG. 1 there is shown a block diagram of the transmitter unit of the invention. The transmitter unit includes a power supply 10 which includes an arrangement to charge the batteries that provide the power supply for the transmitter. Timing circuit 12 is a clock circuit which controls the repetition rate of pulses of a selected width produced by the encoder 14 which is an accurate pulse generator. The radio frequency signal produced by the oscillator 16 is modulated according to encoder 14 output by modulator 18 for controlled

radiation output from the tuneable antenna 20. A transmitter unit which consists of the foregoing basic circuits will produce an output signal at a selected frequency which signal consists of pulses of a predetermined width which are repeated at a predetermined rate. The frequency, pulse width and repetition rate of the pulses are determined by the components of the various circuits and as previously indicated, various combinations of these parameters can be utilized to produce a specific output signal that can be utilized to produce the desired action only when a receiver designed and tuned for that specific signal receives it.

Referring to FIG. 3, the power supply 10 consists of batteries B1, B2 and B3 coupled with phone jacks J1 and J2 which are utilized to permit the transmitter unit to be plugged into a charging unit (not shown) to charge the batteries when the unit is not in use. The arrangement also will automatically turn the transmitter on when it is disconnected from the charging unit.

Timing circuit 12 includes a unijunction transistor Q1, the emitter of which is coupled to resistor R1 and capacitor C1, and load resistors R2 and R3 coupled to the bases B2 and B1 of transistor Q1, respectively. Timing circuit 12 controls the repetition rate of the pulses generated by encoder 14 and therefore B1 of transistor Q1 is coupled through capacitor C2 to the base of transistor Q2, and the collector of transistor Q2 is coupled through capacitor C3 to the base of transistor Q3. The encoder circuit 14 thus generates pulses of a width that is determined by C3 and R6, the pulses produced being started by timing circuit 12.

The oscillator circuit 16 shown in FIG. 3 is a crystal controlled oscillator utilizing crystal 22 which is selected to produce an output signal of the desired frequency. The frequency so generated is then modulated by modulating circuit 18 before transmission from the antenna 20. As shown in FIG. 3, the modulating signal is injected into the base of transistor Q5 by coupling the base of transistor Q5 to the collector of transistor Q3 through resistor R7.

With the foregoing described transmitter, a pulse-coded output will be produced at a predetermined frequency in the near radiation field. By proper selection of the components of the transmitter and receiver sensitivity, the near field limit will be placed the desired distance from the transmitter antenna 20. For example, a near field limit of four or five feet can be selected depending upon the use to which the system is applied. If the system is applied in a bank for locking and unlocking teller's cash drawers, a near field of 4 or 5 feet is practical. Use of the near field allows the use of low power thus permitting the use of transistors and a battery operated power supply so that the transmitter is readily portable and compact and can be easily carried on the person. Also, a near field limit of only several feet minimizes interference from other sources, and to other equipment.

Referring now to FIGS. 2 and 4, there is shown the schematic circuitry for a receiver unit constructed according to the principles of the invention. The receiver unit includes a receiving antenna 24 the signals from which are amplified by tuned RF amplifier 26 which is in turn coupled to the input of a mixer stage 28. In the mixer 28, the amplified RF signal is combined with the output of a local oscillator 30. The oscillator circuit 30 shown in FIG. 4 is a crystal controlled oscillator producing a frequency that differs from the oscillator fre-

quency of the transmitter by the IF frequency. The IF frequency generated by mixer 28 is amplified in a two-stage IF amplifier 32 and is coupled to the input of a diode detector stage 34. The detector stage 34 converts the amplified IF signal to pulses, and the detected signal is conditioned to sharper pulses by the conditioning circuit 36. If desired in certain applications where noise is a problem, circuitry can be included to lock out unwanted noise from the output signal of the conditioning circuit 36. However, in the specific embodiment of the invention disclosed herein, no such circuitry is shown. An automatic gain control circuit 38 is used to set the correct operating levels and thus the distance between the transmitter and receiver antenna for proper operation. The standard pulse generating circuit 44 produces a signal with a settable pulse width at a repetition rate determined by the incoming signal from the conditioning circuit 36. The output of the pulse generator 44 is coupled to the input of each stage of the two-stage comparator 42, the one stage of which will produce an output only if the pulse from the pulse generator 44 is narrower than the pulse from the conditioning circuit 36, whereas the other stage of the comparator circuit 42 will have an output only if the pulse of conditioning circuit 36 is narrower than the pulse of pulse generator 44. The comparator 42 includes a diode adder D6 and D7 which has an output if either stage of the comparator circuit 42 has an output. If an output is produced from the diode adder, the signal will be gated by error gate 46 only if the pulse width of the signal from the diode adder is within the preset limits. The integrator and output circuit 48 is used to filter and furnish the power to control the electro-mechanical components of the control circuit 50 which in the embodiment of FIG. 4 includes a relay 54 and a buffer amplifier 56. Voltage regulator 52 furnishes regulated electrical power to all critical receiving and decoding circuits for maximum system stability. Also, a manual override as indicated in FIG. 4 is included so that the relay 54 can be operated in the event of power failure.

Thus, if the receiver shown in FIG. 4 receives a signal at the predetermined frequency, pulse width and pulse repetition rate, the signal will be gated out to the control circuit 50 to cause actuation of the appropriate electro-mechanical components such as relay 54. The transmitter power, receiver sensitivity, and antenna design are all used in such a manner to make the distance between the transmitter and receiving antennas predictable as to the repeatable, accurate transmission of signals between the antennas. In locking-unlocking applications for our invention, with a transmitter unit producing an output signal of a preselected frequency, pulse width and pulse repetition rate within a near field of several feet, a receiver designed to produce an output only if that particular signal is detected, will produce an unlocking action whenever the receiver is within the near field range of the transmitter. For example, if the system is used in a vehicle door-lock application, the receiver would be located in the vehicle and operatively connected to the locking mechanism. The portable transmitter would be carried on the owner's person so that whenever the owner was within a predetermined distance of the vehicle, the doors would be unlocked automatically but would lock automatically when the person carrying the transmitter moved outside of the near field range.

Another very useful application for the invention is for automatically locking and unlocking teller's cash drawers in financial institutions. In such an application, a receiver would be located at each teller's station and operatively connected to the locking mechanism of the cash drawer. A transmitter would be carried by each teller. Each transmitter-receiver combination would be designed to operate on a frequency, pulse width or pulse repetition rate different from the other systems used in that bank. By varying one or more of these parameters, each teller's transmitter will produce an output signal that will actuate only his particular cash drawer lock. With the circuitry shown in FIGS. 3 and 4, when combined with appropriate mechanical arrangements which do not form a part of this invention, a teller's cash drawer will be automatically unlocked anytime he is within the predetermined near field designed into the transmitter. Also, whenever the teller moves outside of his predetermined range, the cash drawer will automatically close and lock. Using the circuits of the invention in such an application will assure that whenever a cash drawer is unattended, it will be automatically locked.

The system of the invention can also be utilized in a variety of other locking applications such as cash register drawers in retail establishments, and particularly establishments such as gasoline service stations where the attendant must frequently leave the cash register to move to the automobile service area. By intentionally utilizing what in most situations is an undesirable characteristic, namely the near field radiation, the invention provides for an automatic lock-unlock feature that in that applications will greatly minimize theft. The invention also has utility in systems other than locking applications, but in the specific embodiment disclosed herein the component values indicated are for a lock-unlock cash drawer application in financial institutions. Although the invention is described in connection with such a preferred embodiment, it will be obvious to those skilled in the art that various revisions and modifications can be made in the specific circuitry and values disclosed without departing from the spirit and scope of the invention. It is our intention, however, that all such revisions and modifications as are obvious to those skilled in the art will be included within the scope

of the following claims.

We claim:

1. A remote control system for controlling actuation of an electro-mechanical transducer, said system comprising a low-power portable transmitter for generating when powered an output signal at a selected frequency, which signal has an appreciable intensity only within a predetermined short range in the near radiation field, said transmitter including means for modulating said signal with pulses of a selected width that are repeated at predetermined regular intervals, a power supply, a timing circuit for controlling the repetition rate of said pulses, a pulse generating circuit for setting the width of said pulses, an oscillator coupled to the output of said pulse generating circuit for providing a modulated R-F signal, and a tuneable antenna for controlling the radiation output from said transmitter, and a receiver located remotely from said transmitter and capable of producing an output to actuate said transducer, said receiver having a sensitivity responsive only to a signal of the intensity of the near field signal generated by said transmitter within said predetermined range, said receiver including a receiving antenna, an R-F amplifier for amplifying signals received by said receiving antenna, an oscillator for generating an output signal at a selected frequency, a mixer coupled to the outputs of said amplifier and said oscillator for combining said output and producing an I-F signal, an I-F amplifier for amplifying the I-F frequency of said mixer, a detector coupled to the output of said I-F amplifier to convert the signal from said amplifier to pulses, a pulse generator for generating standard reference pulses, a two stage comparator having each stage coupled to the output of said pulse generator and to the output of said detector, an error gate coupled to the output of said comparator to produce an output signal if the output of said comparator is within preset limits, and an integrator circuit coupled to the output of said error gate and to said electro-mechanical transducer, said receiver thereby being adapted to produce an output only if it receives a signal of pulses at the selected width and regular intervals and at the frequency of the output signal of said transmitter.

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