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Lester

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[54] ELECTRONIC RECOGNITION DOOR LOCK

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[52] **U.S. Cl.**.....**70/153**, 70/277

[51] **Int. Cl.**.....**E05b 47/06**

[58] **Field of Search**.....70/277, 278, 283, 70/153

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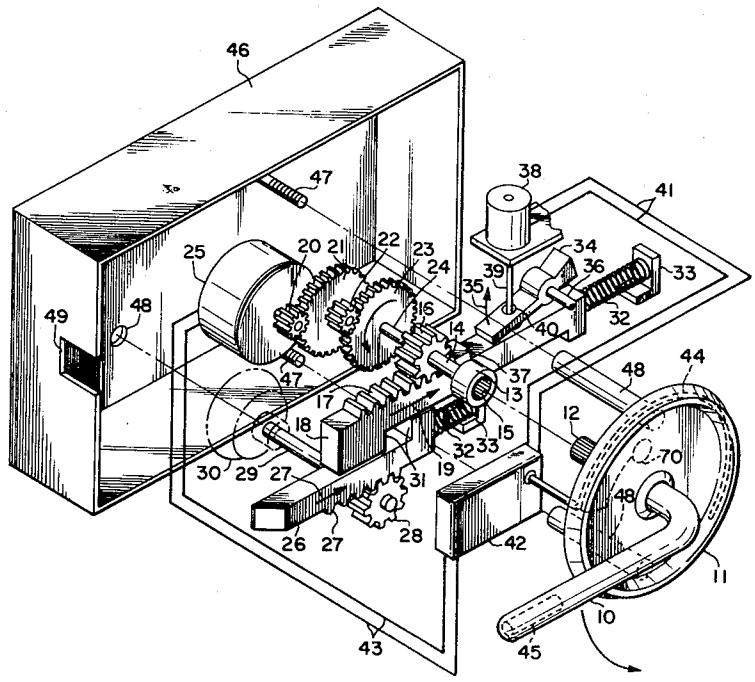
[57] **ABSTRACT**

An electronic, door lock controlled by a passive transponder used as a key by the person desiring to open the door. A hand-operated electric generator is coupled by a gearing system to the door handle, and generates power to operate a door lock transceiver which receives coded signals from the personal transponder to open the lock. Upon the reception of properly coded signals, a solenoid is activated to withdraw an abutment member from the path of a laterally slidable door bolt mechanism so that the door may be opened. The personal transponder may be disposed within a watch case, or have the size and shape of a conventional writing pen. The system may be radio frequency or ultrasonic.

16 Claims, 7 Drawing Figures



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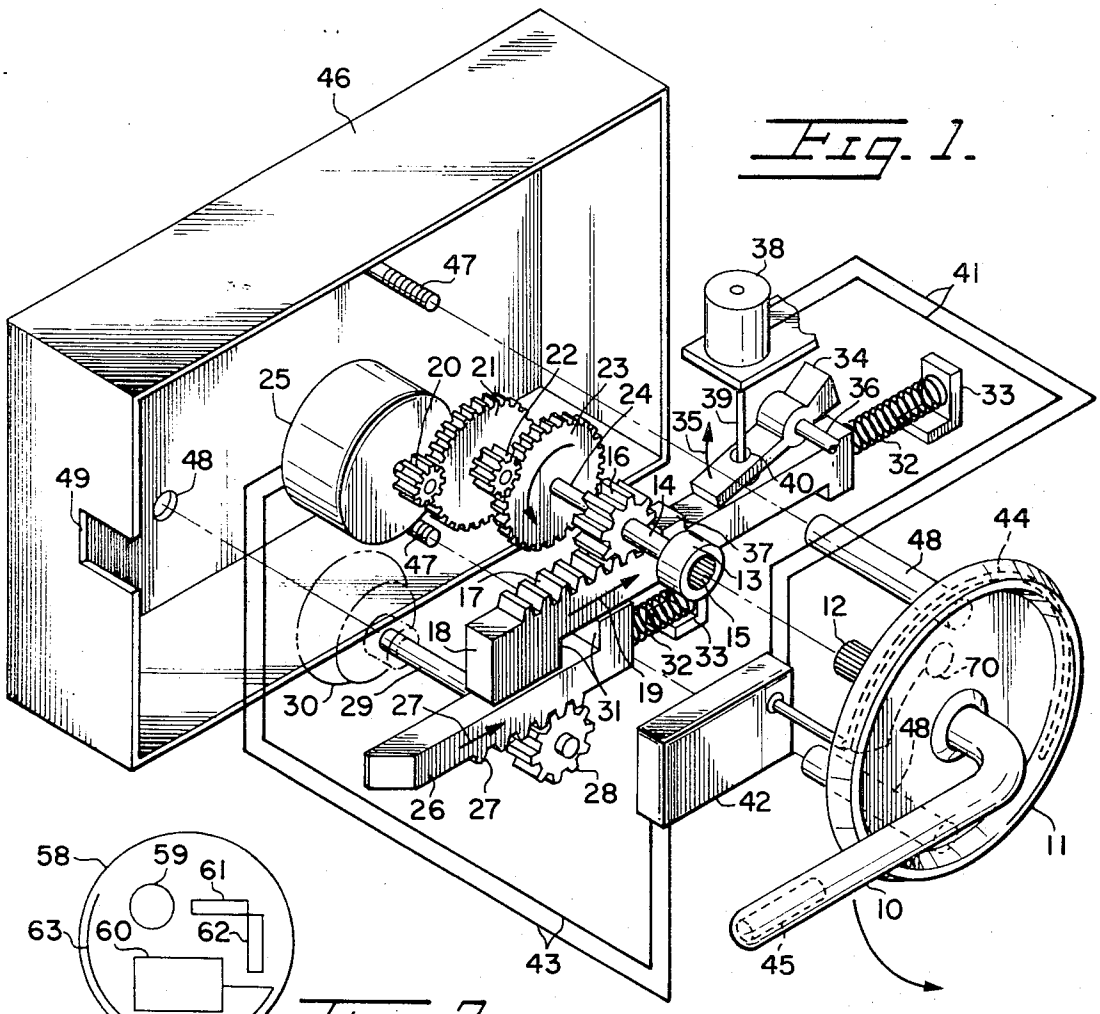

Fig. 1.

Fig. 2.

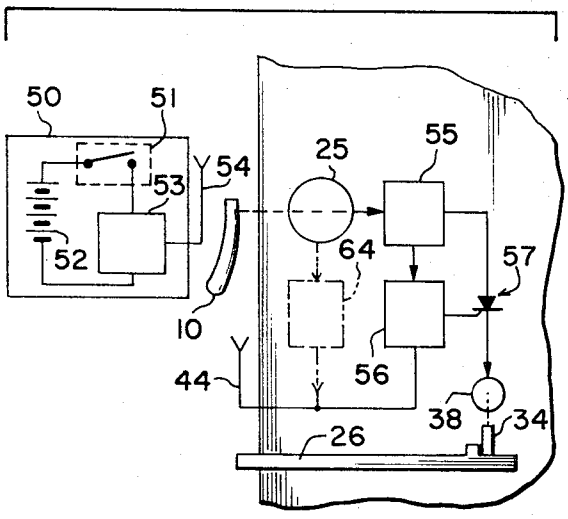

Fig. 3.

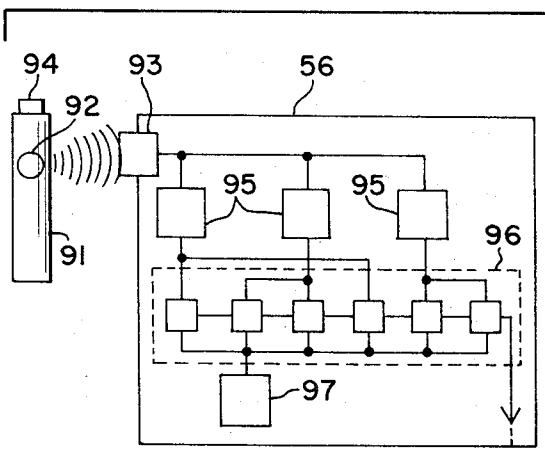

Fig. 4.

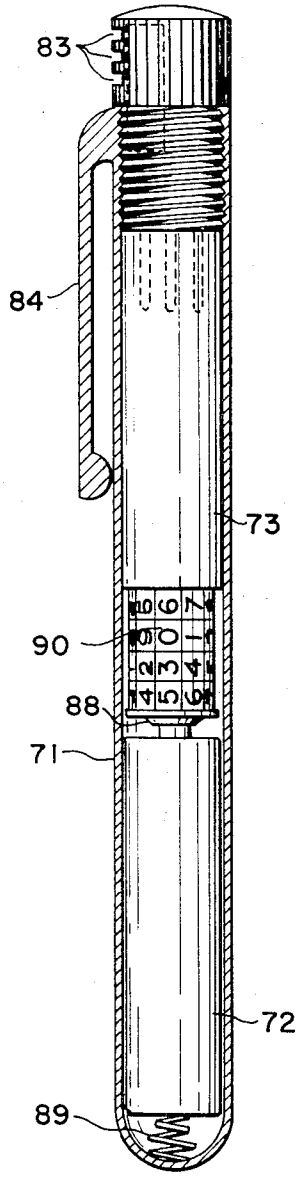

FIG. 5

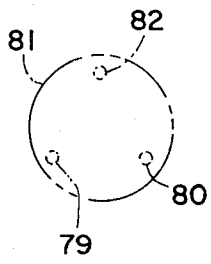

FIG. 5B

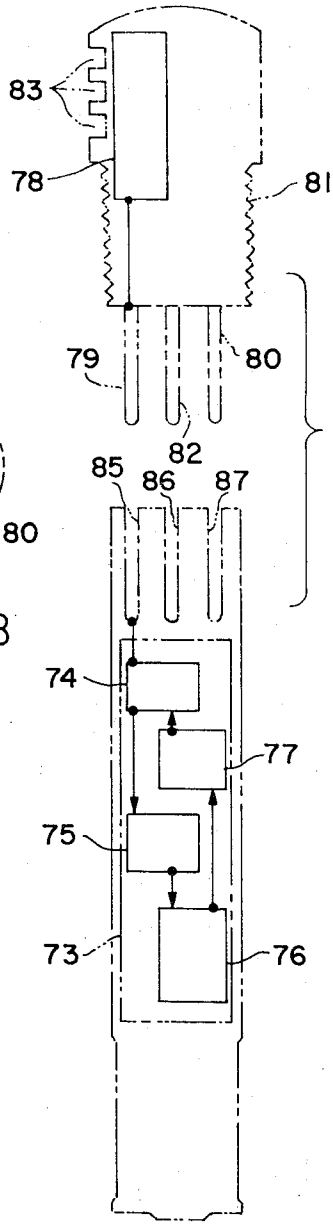

FIG. 5A

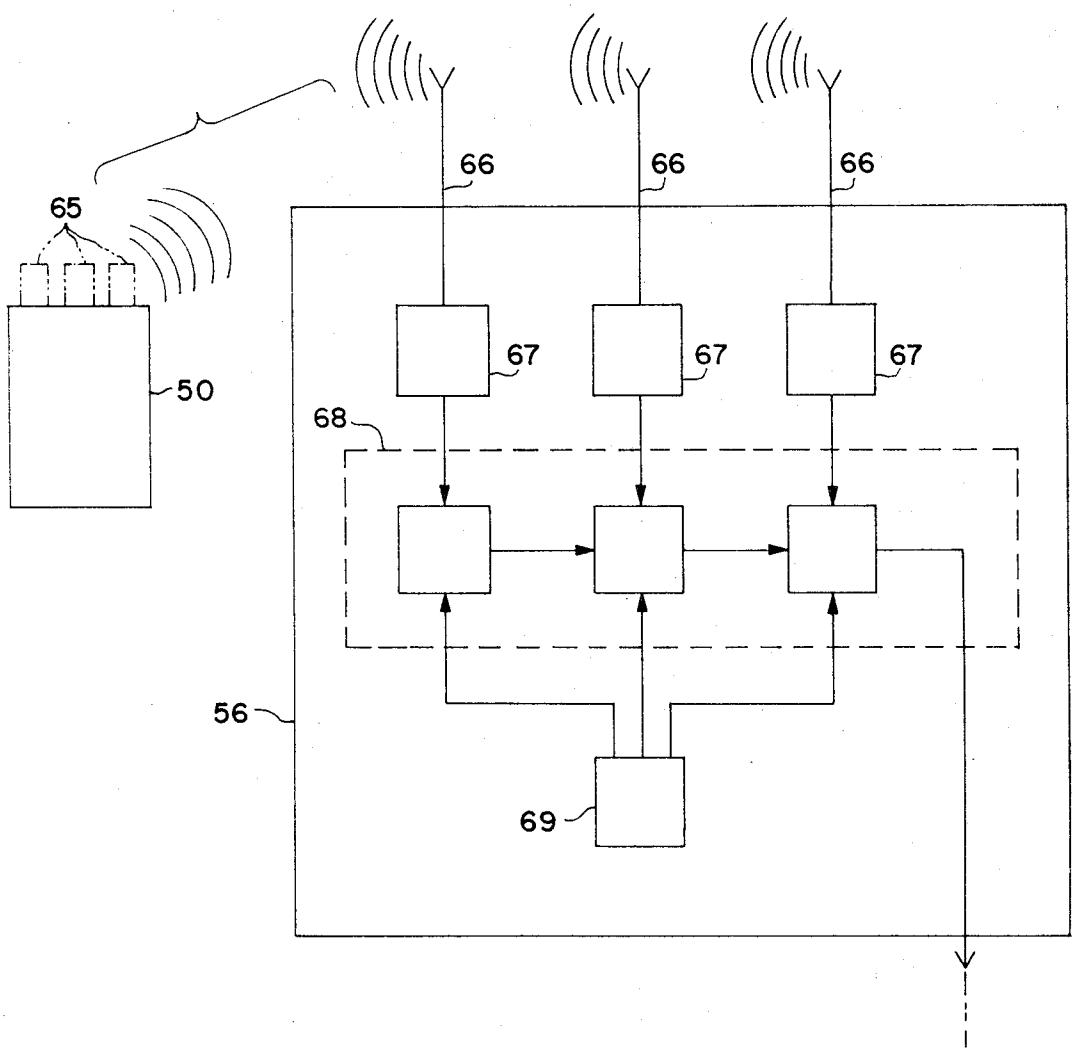

Fig. 6.

ELECTRONIC RECOGNITION DOOR LOCK

The present invention relates to electronic locks, and in particular, to an electronic recognition lock which automatically releases an electronically controlled door bolt in response to the reception of a coded sequence of signals transmitted by a transponder unit carried by a person desiring to open the lock.

Conventional key lock systems are undesirable for a variety of reasons. For example, in the dark, a person must first find his key, and then insert it in the lock, in order to gain entrance to his home or apartment. If the person is carrying a number of packages or other items, or a keychain with many keys, opening the lock is made more difficult. Inclement weather conditions further complicate the process. Furthermore, keys may be lost, stolen or copied by unauthorized persons in order to gain entrance to a house or apartment.

Accordingly, the applicant provides an electronic recognition lock which electronically controls a door bolt in response to the reception of a plurality of coded signals which the lock mechanism is programmed to decode and identify to determine if the lock is to be opened. The door handle is coupled by a gearing system to an electric generator, which generates power in response to rotational movement of the handle to power the electronic controls of the door lock. A rack and pinion is coupled to the door handle, and controls the movement of the door bolt. A pivotable stop member is slidably adjacent the rack and pinion, and abuts a corresponding abutment member on the rack to limit movement of the door handle. The stop member is coupled to a solenoid, which is electrically coupled to the electronic controls of the door lock, and mechanically coupled to the stop member. The solenoid is activated and pivots the stop member from its limiting position when a signal of the proper code is received by the door lock control mechanism. The rack and pinion then bypasses the stop member and the handle is fully rotated to release the door bolt and admit the person to the house or apartment.

In one embodiment of the invention, the door lock is controlled by a wrist watch including a radio frequency signal transmitter, which transmits the coded sequence of signals to the door lock. The watch is biased in a "passive" or deactivated state, and is activated by a magnet disposed in the door handle which vibrates a pair of reed switches in the watch when it is placed in proximity to the magnet. The switches connect the power source to the transmitter to start transmission of the signals. An antenna is disposed in the door adjacent the handle for receiving the signals transmitted from the watch.

In another embodiment of the invention, a radio frequency signal transmission unit, having three external buttons projecting from its case, is used to control the lock instead of the watch. The three buttons are coupled to three separate transmitter circuits which transmit signals separately at three different frequencies. The door lock control system has a three frequency receiver and a shift register coupled to the receiver, for receiving the transmitted signals and processing them to determine if they were transmitted in the proper sequence. The door lock is released by the electronic apparatus when signals of the predetermined frequencies are received in the proper coded sequence.

In other embodiments of the invention, a single push button switch, projecting from the casing of the radio frequency transmitter, is used to switch the transmitter from a normally passive to an active state, in which the transmission of the coded signals is automatically carried out by the electronic circuitry of the transponder. The personal transmitter may also be completely automatic, transmitting the coded signals in response to a signal generated by the electronic door apparatus.

In still other embodiments of the invention, the system may be ultrasonic, using ultrasonic transducers to transmit the signals required to open the lock.

It is therefore an object of the present invention to provide an electronic recognition lock which is opened by a remote transponder which identifies the person carrying the unit.

It is another object of the present invention to provide an electronic recognition lock which is completely automatic, and which requires no conscious effort on the part of the user to open the lock.

It is a further object of the present invention to provide an electronic recognition lock which is simple in design, easy to manufacture, and efficient and reliable in operation.

Other objects and features of the present invention will become apparent from the following detailed description taken in connection with the accompanying drawings which disclose several embodiments of the invention. It is to be understood, however, that the drawings are designed for the purpose of illustration only, and are not intended as a definition of the limits and scope of the invention.

Referring to the drawings, wherein similar reference characters denote similar elements throughout the several views:

FIG. 1 is a perspective view of an electronic door lock constructed in accordance with the present invention;

FIG. 2 is a schematic diagram of a wrist watch sized transponder for controlling the door lock of FIG. 1, constructed in accordance with the present invention;

FIG. 3 is a schematic diagram of the electrical and mechanical elements of the door lock and personal transponder;

FIG. 4 is a schematic diagram of a personal transponder and the electronic components of the receiver of an ultrasonic door lock constructed in accordance with the present invention;

FIG. 5 is a cross-sectional vieww of one embodiment of a personal transponder for controlling view door lock of the present invention; and

FIG. 5A is a schematic diagram of the electronic components of the personal transponder of FIG. 5.

FIG. 5B is an end view, in phantom, of the piezoelectric transducer section of the personal transponder of FIG. 5.

FIG. 6 is a schematic diagram of another embodiment of personal transponder and of the electronic components of the receiver of a radio frequency electronic door lock constructed in accordance with the present invention.

Referring to the drawings, in particular FIG. 1, there is shown an L-shaped, rotatable door handle 10, disposed through an annular door plate 11, having gear teeth 12 provided on the end of the handle disposed through the door. Gear teeth 12 are slidably disposed within a cylinder 13 mounted on the end of a shaft 14,

and mesh with gear teeth 15 provided on the inside surface of cylinder 13. A coarse pitch spur gear 16 is also mounted on shaft 14, and meshes with a gear rack 17 of the same pitch provided on a slidable control bar 18, which moves laterally in the direction of arrow 19. A stepup gearing system, consisting of gears 20, 21 and 22, and drive gear 23 attached to extension 24 of shaft 14, couple the door handle with the rotor shaft of a permanent magnet, AC generator 25.

A door bolt 26 is slidably disposed beneath control bar 18, and has a coarse pitch rack 27 provided on the bottom surface thereof, which meshes with the spur gear 28 mounted on a rotatable shaft 29 to which an inside door knob 30 is attached. Door bolt 26 moves laterally in the direction of arrow 27 when door knob 30 is rotated to open the door. Both control bar 18 and door bolt 26 have abutment members 31, integrally formed at their ends perpendicular to the longitudinal axis of the bar and door bolt, for engaging each other when handle 10 is turned, and causing control bar 18 to pull door bolt 26 from the door latch. Compression springs 32 engage the ends of the control bar and door bolt, for returning them to their illustrated positions after the door is opened. The springs are secured in place engaging the ends of the door bolt and control bar by L-shaped retaining members 33.

A pivotable stop member 34, movable upwardly in the direction of arrow 35, is mounted on a stationary shaft 36, and is biased so as to normally engage the top surface of control bar 18. As control bar 18 is moved laterally in the direction of arrow 19, an abutment member 37 provided at the end of rack 17 engages the end of stop member 34 and prohibits further movement of the control bar to displace door bolt 26 and open the door. When member 34 engages abutment member 37, members 31 on control bar 18 and bolt 26 are positioned almost in engagement with one another. Stop member 34 thus prevents lateral disposal of bolt 26 to open the door, unless it is pivoted upwardly, in the direction of arrow 35, to allow the control bar to slide laterally past it and pull the door bolt from the door latch.

Member 34 is coupled to an electrical solenoid switch 38 by a vertically movable cylindrical rod 39 disposed through aperture 40. Rod 39 has an annular disc affixed to its end perpendicular to its longitudinal axis to lift the stop member. Electrical wires 41 couple the solenoid to electrical control unit 42, which is coupled to generator 25 by wires 43. Control unit 42 has a transmitting and receiving antenna 44 disposed about the periphery of annular door plate 11. Permanent magnet 45 is disposed in the end of handle 10 for controlling the remote transponder, which is described below.

The mechanical and electrical components of the door lock are mounted within a rectangular casing 46 which abuts the interior surface of the door. Annular door plate 11 is disposed on the exterior surfaces of the door, and is coupled by bolts 47, which are threadably engaged in cylinders 48 attached to plate 11, to the rectangular casing. When bolts 47 are tightened, the plate and casing engage the inside and outside surfaces of the door and secure the door lock in its mounted position. Shaft 29 for door knob 30 is disposed through circular aperture 48, and a rectangular-shaped notch 49 is provided in the side of the casing adjacent the door latch 40, through which bolt 26 extends.

The electrical control system of the door lock and transponder is shown in detail in FIG. 3. In general, the personal transponders 50 carried by the persons using the lock include a reed switch 51 responsive to the presence of a magnetic field coupled to a battery 52 to power the transponder, and an electronic transmitter 53 which transmits coded radio frequency signals through antenna 54. The electronic door lock includes generator 25, which is mechanically coupled to door handle 10, coupled to a rectifier and filter 55 and UHF receiver 56. A silicon controlled rectifier 57 couples rectifier-filter 55 and receiver 56 to solenoid 38. The solenoid is mechanically coupled to stop member 34 which is moved out of the path of control bar 18 when the solenoid is activated.

FIG. 2 illustrates, in schematic form, one embodiment of a personal transponder for controlling the electronic door lock. The electrical components of the pocket transponder are disposed in a watch case 58 and include an annular-shaped battery 59, an integrated circuit transmitter 60, and a pair of reed switches 61 and 62 for coupling the battery to the transmitter when watch case 58 is placed near magnet 45. The switches are positioned perpendicular to one another to ensure that at least one will will be activated by the magnetic field of magnet 45 regardless of the position of the user's hand or wrist when he grips handle 10 to open the door. Antenna 63 is coupled to the transmitter to radiate the rf signals from the transponder.

The personal transponder is normally set in a "passive" state, that is, the power source is not coupled to the transmitter continuously, but only activates the transmitter when the person approaches handle 10 and magnet 45 causes the reed switches in the personal transponder to close and couple the battery power source to the transmitter and other electrical components of the transponder unit. A modulated signal is then transmitted from the personal transponder and is received by antenna 44 of the door lock control unit. Simultaneously, as the person turns handle 10, the gear system coupled to generator 25 rotates the generator shaft at a sufficiently high angular speed so that the generator rotor produces sufficient electrical power to operate receiver 56, rectifier-filter 55, and solenoid 38. When a signal of the proper code is received by the door unit, silicon rectifier 57 is switched on to activate the solenoid. Generator 25 produces an alternating current output, and preferably does not include brushes or a commutator. Its AC output is converted to a DC output which activates receiver 56 and rectifier 57 through rectifier and filter 55. When a signal having the proper code is received, and rectifier 57 is switched on to activate solenoid 38, rod 39 then pulls member 34 upwardly so that abutment member 37 may slide past and control bar 18 may pull door bolt 26 from the door latch. When the handle is released, compression springs 32 force the control bar and door bolt back to their original positions, thereby locking the door.

The door is opened from the inside by means of door knob 30, which is coupled directly to door bolt 26. When this knob is rotated, only the door bolt moves, and the remaining portion of the door lock remains stationary. Compression spring 32 returns the door bolt to its original position as soon as knob 30 is released. If a person not having a transponder unit attempts to open the door, stop member 34 prevents control bar 18 from moving past it and consequently, handle 10 cannot be

turned to pull door bolt **26** from the door latch. Member **34** is "fail-safe," since the force of gravity always forces the stop member to engage the face of control bar **18** whenever the solenoid is not activated.

The personal pocket unit, once activated, continuously transmits the coded signal to the door unit. When the door opens, and the person pulls his hand away from magnet **45**, the switches in the transponder unit are opened and the transmitter power source disconnected. The transponder then returns to its "passive" state, which prevents constant drain on the battery power source. Longer battery life and less maintenance are thus assured. Activation of the transponder unit, and transmission of the coded signals to open the door lock occur within a fraction of a second so that the person opening the door is unconscious of the entire unlocking process. As the user turns the handle, if the received signal is of the proper form, the solenoid is activated before abutment member **37** engages the end of stop member **34**. Thus, the door is opened by the person as if door handle **10** were directly coupled to door bolt **26**. The door lock, however, is preferably equipped with an energy storage capacitor, which stores the electrical energy produced by the generator and enables the receiver circuit and the solenoid to continue to operate for a brief period of time after the rotational movement of handle **10** stops in case noise or other interference causes signal processing difficulties.

Instead of using magnet **45** and reed switches **51** to activate the personal transponder, a radio frequency transmitter **58** may be added to the electronic control so the door lock. In combination with receiver **56**, a transceiver is formed which transmits a signal at a selected frequency to the personal transponder and receives its reply signal, in response to the rotational movement of the handle and the consequent generation of electrical power. In the personal transponder, receiver **53** is replaced with a transceiver which receives the signal from the door unit, switches the transponder on, and then transmits the coded signal to open the door lock. The transponder is provided with a loop or coil, which is resonant at a selected frequency at which radio frequency signals are transmitted by the door unit. When these signals are received by the personal transponder, the received alternating signals are converted by a solid state rectifier provided in the transponder to DC power which activates the personal transponder transmitter. The transponder then transmits a reply signal to the door unit, at a different frequency than that used by the door lock transmitter so that the signals are not confused, which is received by the transceiver in the door unit to activate the solenoid and release the door bolt. It is preferable that the frequency of the signals transmitted by the door unit and the signals transmitted by the personal transponder are separated by a large portion of the frequency spectrum so that the lock transmitter does not affect the lock receiver.

The battery for the personal transponder is permenently connected to the transponder transmitter in this embodiment of the invention. However, the current drain from the battery under quiescent conditions is negligible, since there is no forward bias on the base-to-emitter junction of the solid state rectifier. The required forward bias is provided by the rectified output of the pickup coil in the transponder when a signal from the door unit is received. This embodiment of the invention differs from the previously described embodiment only in that the transponder is not "passive." It is switched on continuously, in order to receive transmitted signals from the door lock unit.

With a transponder of this type, constant recharging of the battery is necessary. If the system is used within a business office, hospital, etc., the employees could leave their transponders on a charging rack each day at quitting time to recharge the batteries. In order to remind employees who forget, the charging rack may be equipped with a transmitter, which continuously sends out a coded signal into the immediate area of the employee exit to activate an audible transducer in the transponder and remind the employee to put his transponder on the rack when the audible tone is produced. Otherwise, the operation of this embodiment is the same as the system described previously. In both of the above-described systems, the personal transponder may be made passive by providing a manual pushbutton switch on the outside of the transponder unit casing. With this switch, the person using the lock activates the transponder before turning door handle **10** to gain entrance. The coded signal is then transmitted to the door unit to activate the solenoid and release the door bolt.

In systems which require more security, a personal transponder and door lock unit may be modified so that the door can be opened only in response to the transmission of a finite number of radio frequency signals of different frequency in a selected sequence. In the embodiment illustrated in FIG. **6**, personal unit **50** is modified so that its transmitter transmits radio frequency signals at three different frequencies, and receiver **56** is modified so that it receives the three frequencies transmitted from the personal transponder and responds only to a particular sequence of these signals. The transponder has three pushbutton switches **65** projecting from its casing, each of which is connected to a battery power source for the transponder and one of three different capacitors having different capacitance values. Thus, the depression of each of the pushbutton switches couples the battery of the transponder and each capacitor separately to the transmitter of the transponder. Three different radio frequency signals are thus transmitted to the door unit, and are received by antennas **66**. The antennas are coupled to receivers **67** so as to form a triple receiver which is sensitive to each of the three frequencies transmitted by the transponder. The receivers produce a DC pulse output signal which is transmitted to shift registers**68**, and the shift register delivers a pulse to rectifier **57** to activate solenoid **38** only if the signals transmitted from the transponder are received in the required, predetermined sequence. A reset timer **69** is provided in the receiver to periodically reset the shift registers to their quiescent state to avoid interference from random, spurious signals or improperly sequenced signals. When the pushbuttons are not depressed, the personal transponder remains in a "passive" state.

It should be noted that although three pushbutton switches were used for generating three different frequencies in the above-described embodiment, any number of switches and frequencies may be used, depending on the security required for the particular system. The above embodiment is intended merely as an illustration.

An alternate method of transmitting three different frequencies is to use a single frequency transmitter having three different tone modulators which are actuated by the three separate pushbuttons. The receiver is modified so that only a single receiver, having three different tone sensitive relays or solid state switches feeding the shift registers **68**, is required. The transmission of the three frequencies may also be accomplished automatically by using a time delay system which causes the pocket transponders to transmit at the three different frequencies, such as, for example, a system which goes from one frequency to the next after depressing a single pushbutton switch.

To provide even greater security, the system may be modified so that the signal transmitted from the lock to the transponder is transmitted a selected number of times over different time intervals, and the signal transmitted in response to those signals is transmitted back to the lock within the same time intervals, including time for decoding, to open the door lock. A system of this type can be constructed by providing the lock and pen transmitters with R-C circuits for transmitting the coded signals with a slowly rising amplitude. When the signals are transmitted by the lock with a slowly rising amplitude of a specified time interval, the signals received by the lock must be transmitted by the transponder with a slowly rising amplitude of the same time duration for the lock to open. This system can be combined with the above-described shift register systems so that the signals are transmitted and received at a specified frequency, in a selected sequence, over different time intervals.

Each of the above-described embodiments of the invention may transmit ultrasonic, instead of radio frequency signals. Antenna **44** is replaced by a piezoelectric crystal transducer **70**, disposed in a circular aperture in plate **11**, and coupled to electronic control **42** of the door lock. The personal transponder is modified so that a piezoelectric crystal is coupled to transceiver **53** instead of antenna **54.** A personal transponder using reed switches to activate the transmitter would include a battery, coupled to an oscillator-transmitter and a gate circuit by the reed switch, and a piezoelectric transducer, coupled to the gate switch, for transmitting the desired frequency and pulse modulated signals to the door unit. These signals would be received by transducer **70** of the electronic lock, and transmitted to a receiver-decoder whose output activates solenoid **38** when the proper signal is received. The reed switch may also be a pushbutton switch, coupled to the oscillator-transmitter of the transponder, for switching the "passive" transponder unit on.

An ultrasonic "non-passive" system, which is fully automatic, may be constructed by providing both the electric door lock and the transponder with a receiver-decoder and transmitter-oscillator for transmitting and receiving signals in the same manner as described with respect to the corresponding rf system described above. One embodiment of a personal transponder which may be used with an ultrasonic door control lock is shown in FIG. **5.** Transponder **71** has the dimensions and shape of a conventional writing pen, so that it may be easily carried by the user of the door lock. A battery **72** is disposed in the lower end of its cylindrical casing, and supplies power to an electronic circuit module **73** disposed in the upper portion of the pen. The circuit module comprises a gate or switch **74** coupled to a receiver **75** and a decoder **76.** An oscillator-transmitter **77**, coupled to the decoder, is coupled by gate **74** to a piezoelectric transducer **78** disposed at the top end of the pen through pin **79.** Pin **80** is the ground for the circuit module.

The transponder has a detachable threaded cap **81** including a three-pin coupling element on its bottom surface having pins **79, 80** and spare pin **82.** The cap has a plurality of apertures **83** in its front surface above clip **84** from which the ultrasonic signals are transmitted to the door unit. Apertures **83** are directed towards the front of the pen so that the signals will be transmitted directly at the door lock. Circuit module **73** is cylindrically shaped, and has three corresponding sockets **85, 86** and **87** which receive pins **79, 82** and **80,** respectively. The module is coupled to the cap by the pins, and the assembled structure threaded into thetubular casing of transponder **71.** Battery **72** engages a contact terminal **88** coupled to the module, and is held in place against the terminal by means of a spring **89** disposed between the negative terminal of the battery and the end of the tubular casing. A plurality of rotating switches **90** may be coupled to the circuit module to allow manual adjustment of the frequency to which the transponder will respond. This additional feature produces, in effect, a key and door lock with "tumblers" which may be changed as desired.

It should be noted that the transponder unit just described may also be modified to include a manual pushbutton switch which may be depressed to activate the transponder. With such a unit, only an oscillator-transmitter, battery, and gate would be required to open the door lock, since the remaining electronic components of the control system are no longer needed.

One of the most desirable features of the ultrasonic transponder unit described in FIG. **5** is that it may be used simultaneously with both an electronic door locking system, and an electronic personnel locating system, such as those described in applicant's co-pending patent application, Ser. No. 160,851, filed July 8, 1971, now U.S. Pat. No. 3,696,384, issued Oct. 3, 1972 entitled "Ultrasonic Tracking and Locating System".

An ultrasonic transponder, which is both automatic and passive, may be provided by using a transceiver in the door control unit which transmits a high power DB ultrasonic signal, at, for example, 30,000 cycles, in response to rotation of the door handle, which causes a reed or transducer provided in the transponder to vibrate when the signal is received. The reception of the signal couples the battery of the transponder to the transmitter and activates the transponder. The transponder then transmits a range of ultrasonic signals of varying frequencies, which equal a code sequentially both in time length and frequency. The signals are preferably broadbanded to allow for temperature variations when the units are used outdoors, and should be kept approximately 3 to 5 thousand cycles apart. Both transducers in the door lock and the transponder should be omni-directional.

FIG. **4** illustrates an ultrasonic transponder and door lock similar to the embodiment described with respect to FIG. **6.** Transponder **91** has an exposed ultrasonic transducer **92,** which transmits ultrasonic signals to transducer **93** of receiver **56.** The transponder includes a pushbutton switch **94,** coupled to an automatic shift register, which transmits ultrasonic signals of three dif-

ferent frequencies in the required sequence. The transmitted signals are received by transducer **93**, and frequency selective receivers **95**, and DC pulses from the receivers are transmitted to a shift register **96**, shift register **96** activates the lock control circuits only after signals are received in the proper sequence. A reset timer **87** is provided for the same purpose as in the corresponding radio frequency system. It should be noted that substantially the same circuitry may be used in transponder unit **91** to cause automatic transmission of the three frequencies necessary to open the lock. In such a transponder, the shift register controls three transmitters which generate the desired signals through transducer **92**.

If manual operation is desired, transponder **91** may be provided with three pushbuttons, each controlling the transmission of one selected frequency, as described previously with respect to the radio frequency systems.

It should be noted that generator **25** may be eliminated by electrically wiring the door so that power is supplied to the lock when the handle is turned.

While only several embodiments of the present invention have been shown and described, it will be obvious to those persons skilled in the art that many changes and modifications may be made thereunto without departing from the spirit and scope of the invention.

What is claimed is:

1. An electronic lock, for a door having movable interior and exterior door handles, and a laterally-slidable door bolt coupled to said handles, comprising:

means, coupled to the exterior door handle and the door bolt, for laterally displacing the door bolt in response to movement of the exterior door handle;

means, moveable in and out of engagement with said door bolt displacement means, for limiting the lateral movement of said door bolt displacement means;

means,remotely positioned from said door lock, and carried by each individual using the door lock, for transmitting a coded signal having a form unique with respect to the door lock;

means, coupled to said exterior door handle, for generating electrical power in response to movement of the exterior door handle;

means, coupled to and responsive to the activation of said electric power generating means, for receiving said signals transmitted by said remote signal transmitting means; and

means, responsive to the reception of said coded signals, for positioning said limiting means in and out of engagement with said door bolt displacement means.

2. The door lock as recited in claim **1**, further comprising means for actuating said signal transmitting means to initiate transmission of said coded signals to said door lock receiver means.

3. The electronic door lock as recited in claim **2**, wherein said door bolt displacement means comprises an elongated, rectangular-shaped bar, slidably disposed and laterally moveable in said door, and coupled to said exterior door handle by a gear rack, provided on the top surface thereof, and a spur gear engaging said gear rack, coupled to said exterior handle, said bar also including a downwardly extending end portion disposed perpendicular to the longitudinal axis thereof, for engaging said door bolt and displacing said bolt in response to rotational movement of said door handle.

4. The lock as recited in claim **3**, wherein said control bar further comprises an abutment member, disposed on the top surface thereof adjacent one end of said gear rack, and wherein said limiting means comprises an elongated, substantially rectangular-shaped member, pivotably mounted and biased so as to engage the surface of said control bar and said abutment member, and thereby limit the lateral displacement of said control bar, and prevent displacement of the door bolt when said coded signals are not received.

5. The lock as recited in claim **4**, wherein said electric generating means comprises an electric generator, coupled to said handle by a plurality of gear-wheels, for imparting high angular speed to the rotor shaft of said generator in response to rotational movement of said handle.

6. The lock as recited in claim **5**, wherein said signal transmitting means comprises,

a transmitter, for transmitting said coded signals,

a battery, coupled to said transmitter, and

means, responsive to said transmitter actuating means, for coupling said battery to said transmitter and thereby causing transmission of said coded signals for opening the lock.

7. The door lock as recited in claim **6**, wherein said signal receiving means comprises a receiver, for receiving said transmitted signals, coupled to and responsive to activation of said generator, for generating an output signal in response to the reception of said coded signals.

8. The door lock as recited in claim **7**, wherein said stop member positioning means comprises a solenoid, mechanically coupled to said stop member and electrically coupled to said receiver, for moving said stop member out of engagement with said control bar, so that said bar displaces said door bolt in response to movement of said handle.

9. The door lock as recited in claim **8**, wherein said transponder actuating means comprises a permanent magnet, disposed in the end of said door handle, and wherein said transponder means for coupling said transmitter to said battery comprises at least one reed switch, responsive to the presence of a magnetic field, for coupling said battery to said transmitter when said transponder is placed in proximity to said magnet.

10. The door lock as recited in claim **8**, wherein said means for actuating said transponder comprises a push-button switch, coupled to said battery and said transmitter, for coupling said battery to said transmitter and thereby causing transmission of said coded signals.

11. The door lock as recited in claim **8**, wherein said transponder comprises a three-frequency transmitter, including three pushbutton switches, each coupled to separate frequency generation circuits in said transmitter, for generating a plurality of differently coded signals in a predetermined sequence by pressing said pushbuttons in said sequence, and wherein said door lock receiver comprises a three-frequency sensitive signal receiver, and a shift register coupled to said receiver, for receiving said three coded signals and generating an output signal for activating said solenoid when said signals are received in said predetermined sequence.

12. The door lock as recited in claim **8**, wherein said door lock further comprises a transmitter, for transmit-

ting coded signals from said door lock to said transponder, and wherein said transponder further comprises a receiver, for receiving said signals transmitted from said door lock and actuating said transponder to cause transmission of said coded signals to said door lock.

13. The door lock as recited in claim **8,** wherein said transponder transmitter comprises a three-frequency transmitter, coupled and responsive to the depression of a single pushbutton switch provided on the external surface thereof, and a shift register coupled to said three-frequency transmitter, for transmitting, in a selected sequence, three coded signals for opening said lock, and wherein said receiver in said door lock comprises a three-frequency receiver, and a shift register coupled to said receiver, for generating an output pulse in response to the reception of said plurality of coded signals in said door lock for activating said solenoid and opening the door lock.

14. The door lock as recited in claim **8,** wherein said signals transmitted and received are radio frequency signals, and wherein said transponder and said door lock further comprise antennas, coupled to said transmitters and receivers, for transmitting and receiving said radio frequency signals.

15. The door lock as recited in claim **8,** wherein said signals transmitted and received are ultrasonic signals, and wherein said transponder and said door lock further comprise ultrasonic piezoelectric transducers, for transmitting and receiving said ultrasonic signals.

16. The door lock as recited in claim **15,** wherein said transponder further comprises an elongated, tubular-shaped casing, having the dimensions and shape of a conventional writing pen, a cylindrically-shaped, electronic circuit module disposed within said casing and including said transmitter and receiver, a battery coupled to said module for supplying power to said transmitter and receiver, and an ultrasonic transducer, coupled to said electronic circuit module, for receiving and transmitting said coded signals.

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