

Sept. 28, 1971

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3,608,342

ELECTRIC DOOR LOCK WITH TIME DELAY

Original Filed May 25, 1967

4 Sheets-Sheet 1

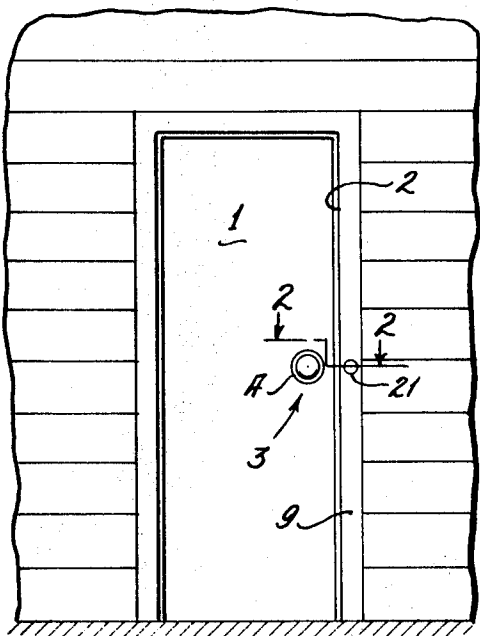


FIG. 1

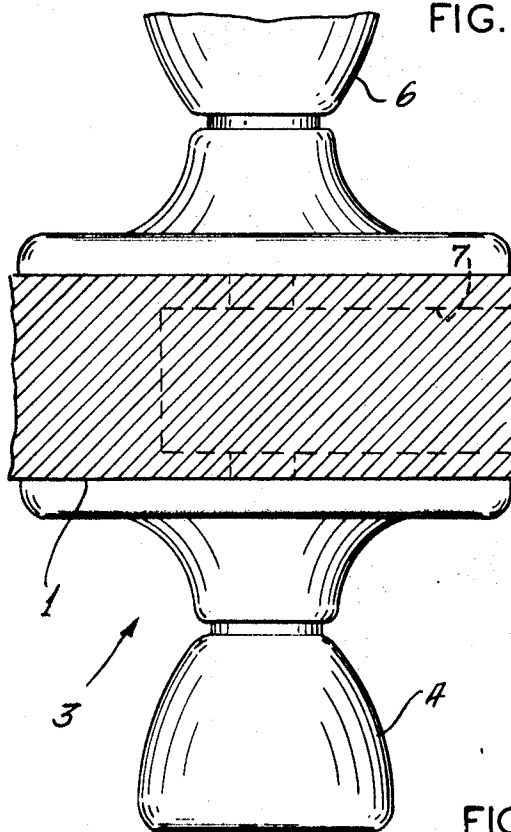


FIG. 2

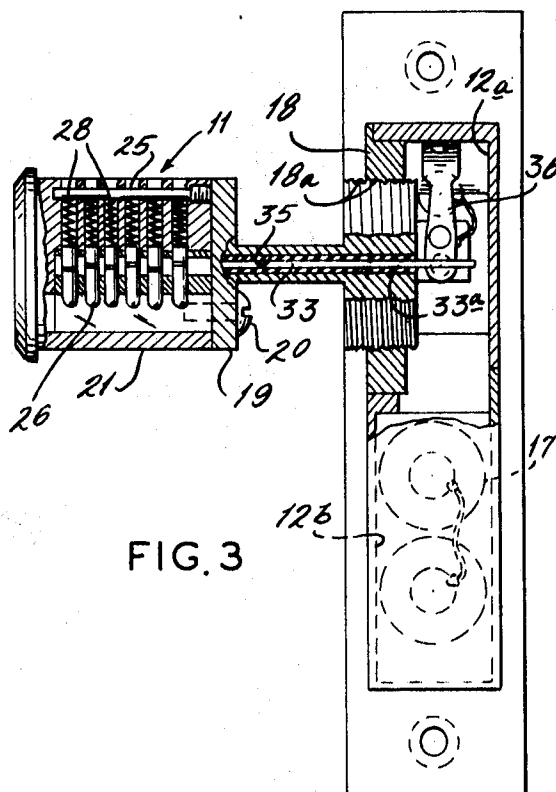
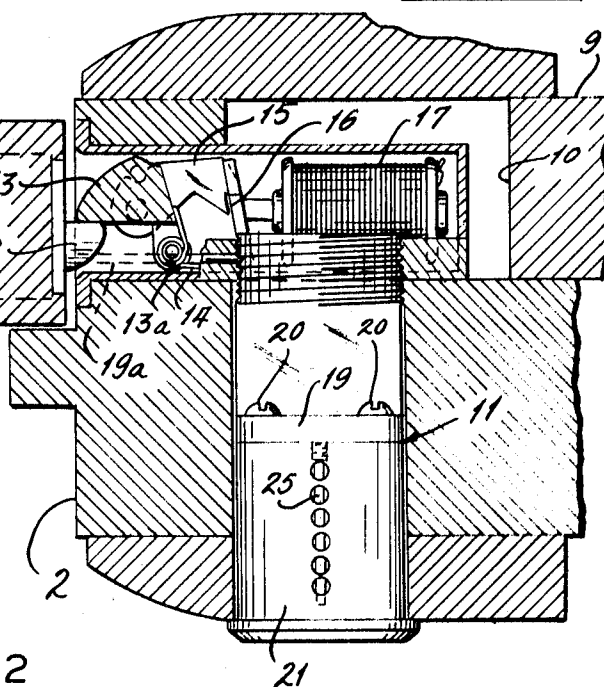


FIG. 3



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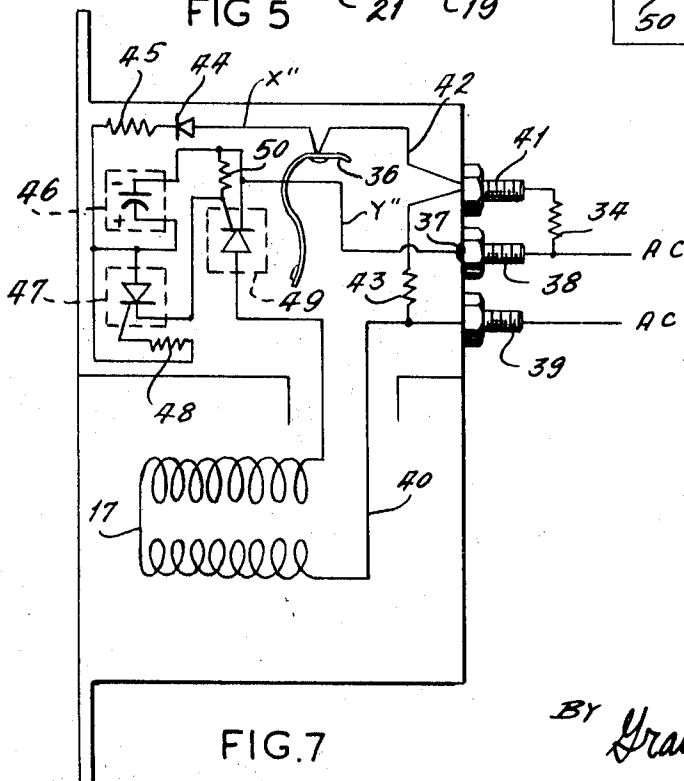
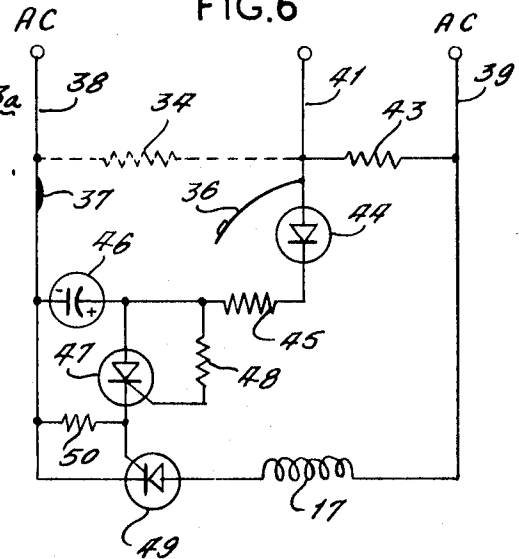
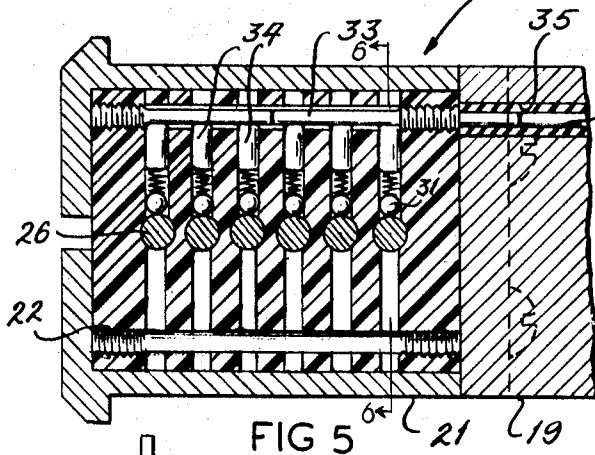
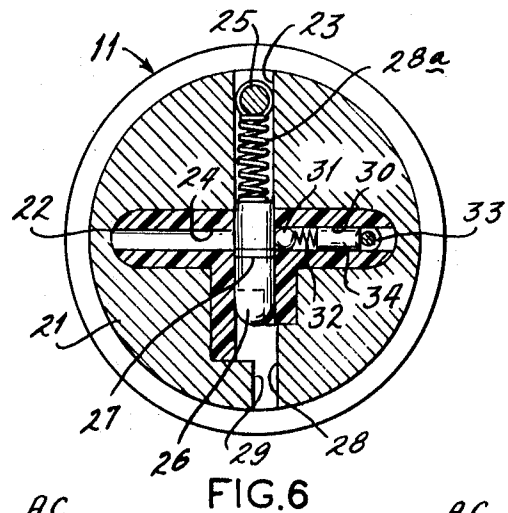
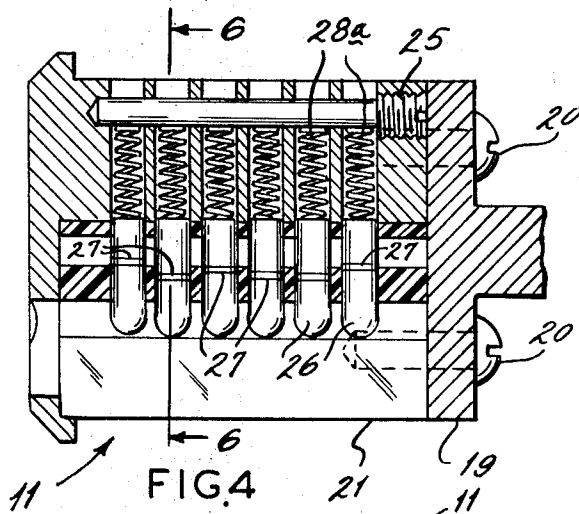


FIG. 8

FIG. 7

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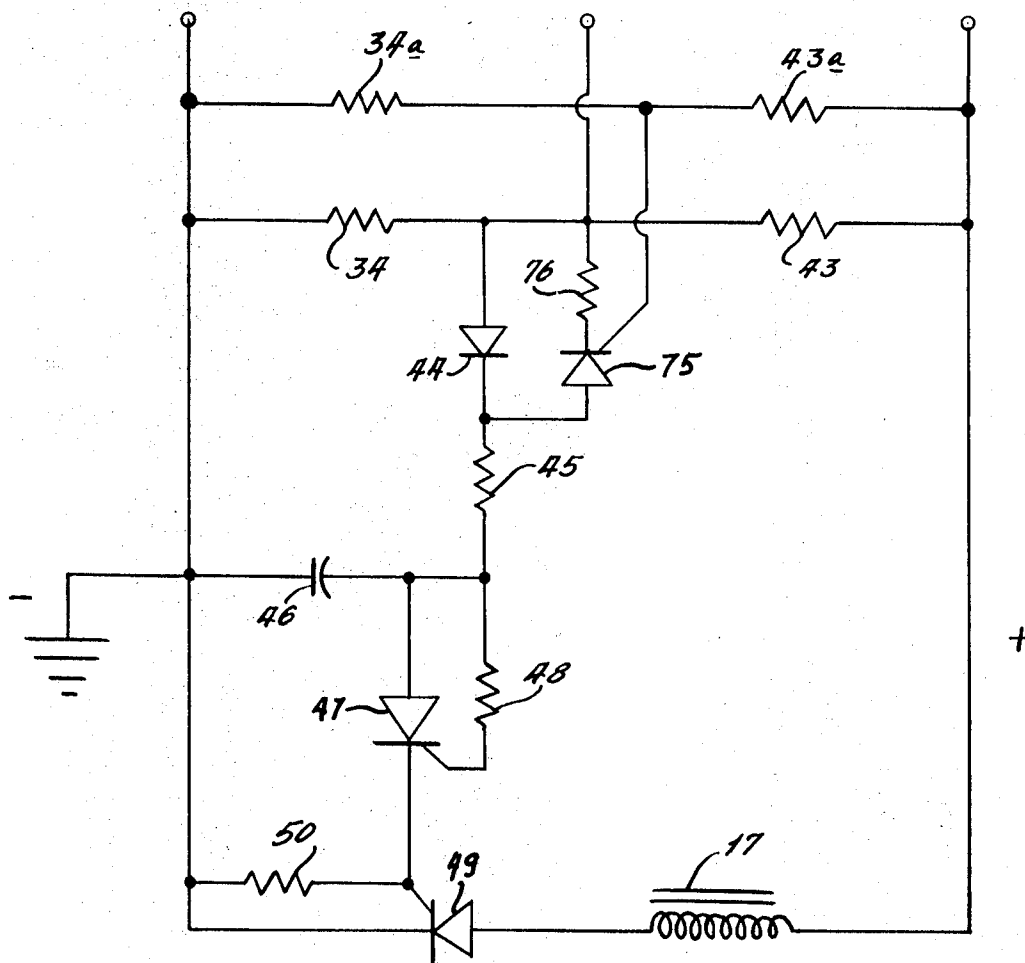


FIG. 12

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1

3,608,342

ELECTRIC DOOR LOCK WITH TIME DELAY

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Continuation-in-part of application Ser. No. 499,674, Oct. 21, 1965, now Patent No. 3,408,838, and a continuation of application Ser. No. 641,309, May 25, 1967. This application Oct. 27, 1969, Ser. No. 869,944

Int. Cl. E05b 39/04, 49/02

U.S. Cl. 70-271

26 Claims

ABSTRACT OF THE DISCLOSURE

An electric lock device for opening an electrically releasable latch means upon insertion of a key into a key slot in the lock cylinder. A time delay including a silicon controlled rectifier and a capacitor-resistance series is used to prevent picking of the lock. The cylinder arrangement comprises electrically conducting pins having insulative bands such that when no key is in the lock, a circuit is completed through the pins and there is not sufficient current through the time delay circuit to activate the latch. When the key is inserted, the insulative bands interrupt the lock circuit so that current flows through the SCR, capacitor-resistance circuit of the time delay, thus when the SCR is triggered, sufficient current passes through the latch to open the latch.

A modification provides a variable time delay and utilizes resistors connected in parallel combinations by different location of the pins. Different keys disconnect different pins and thus cause different time delays to occur before the charge on the capacitor triggers the SCR and opens the latch. This time delay depends on the number of resistors connected into the circuit by the insertion of a particular key. A second SCR is used in the circuit to form a pulsating output. This circuit is termed a relaxation oscillator. A circuit is also used to identify different keys by use of an identification circuit including Wheatstone bridge circuits, having resistors proportional in value as those used in the lock cylinder assembly, to control a neon readout device.

REFERENCE TO PRIOR APPLICATIONS

The present application is a continuation-in-part of my co-pending application Ser. No. 499,674, filed Oct. 21, 1965, entitled Electric Door Lock now U.S. Pat. No. 3,408,838 and is a continuation of application Ser. No. 641,309, filed May 25, 1967 (now abandoned).

BACKGROUND OF THE INVENTION

While electric door locks of a sort are known, principally these devices require that a tumbler be turned so as to establish contact which will open an electrically actuated door latch. Thus, these devices are not particularly dissimilar to conventional mechanically actuated tumbler locks. Other known electric locks with turning parts are easy to pick.

SUMMARY OF THE INVENTION

The present invention comprises an electrically actuated lock device in which a key is inserted into a housing to move conducting pins positioned therein such that the voltage to a triggering device is changed and after a predetermined time, an electrically actuated latch is energized by a SCR and opened. The present invention further comprises a time delay circuit and means for identifying different keys placed in the lock by means of a bridge identification and visual readout device.

2

DESCRIPTION OF THE DRAWINGS

In the drawings, wherein like numbers refer to like parts wherever they occur:

FIG. 1 is a fragmentary front view of a door and building incorporating the present invention,

FIG. 2 is a sectional view taken along lines 2-2 of FIG. 1,

FIG. 3 is a partially broken vertical sectional view through the lock,

FIG. 4 is an enlarged fragmentary vertical sectional view through the lock,

FIG. 5 is an enlarged fragmentary longitudinal sectional view through the lock,

FIG. 6 is a cross sectional view taken along lines 6-6 of FIG. 5,

FIG. 7 is a representation of the electrical parts positioned in the latch housing,

FIG. 8 is a wiring schematic of the lock circuit,

FIG. 9 is a wiring schematic of a modified lock,

FIG. 10 is a wiring schematic of a further modification of the lock,

FIG. 11 is a wiring schematic of a key identification readout circuit, and

FIG. 12 is a schematic of a variable pulsating time delay and selective circuit of a seven-four mastering system.

DETAILED DESCRIPTION

A door 1 is mounted in a doorway 2. A door closure 3, having an outside knob 4 and an inside knob 6 is secured within a door recess or mortice 7. The door closure 3 has a retractable latch 8 which may be operated by the inside handle 6 and the outside knob 4. The door frame 9 of the doorway 2 is provided with a recess or mortice 10. A cylinder mechanism 11 (hereinafter discussed in detail) is mounted in the door frame 2 so that the key recess in the cylinder is accessible from the outside of the door frame 9. A latch casing 12 is mounted in the door frame and is provided with two compartments 12a and 12b.

The lower compartment 12b houses an electrically actuated latch mechanism which includes a locking latch 13 urged into locked position by a spring 14. Latch arms 15 are engaged by a locking bar 16 to retain the locking latch 13 in its locked position. A pair of electromagnetic coils 17, when energized, pull the locking bar 16 toward them to free the locking latch for movement around the pivot member 13a.

Such mechanisms are commercially available.

The upper compartment 12a houses an electronic time delay circuit (hereinafter described in detail) and is provided with a removable metal cover 18. The cover 18 has a threaded opening 18a into which is threaded a cylinder extension 19 which is of conducting material. A set screw 19a holds the cylinder extension 19 in position in the housing 12. Attached to the cylinder extension 19 by means of screws 20 is a conducting lock cylinder 21 which is provided with a T-shaped slot into which is inserted an insulated housing 22 (FIG. 6). The cylinder 21 is provided with a plurality of aligned tubular sockets 23 which are aligned with corresponding sockets 24 in the insulating housing 22. The cylinder extension 19 is to provide for door jambs of differing thickness.

A conducting retainer screw 25 connects the tops of the slots 23 and prevents the pins 26 from coming out of the tops of the slots 23. The pins 26 are of conducting material and are provided with insulative portions 27 (such as plastic bands). A conducting spring 28a urges the pins 26 into the slots 24 of the housing 22.

The housing slots 24 communicate with an open bot-

tom keyway 28 in the housing 22 and the pins 26 extend downward into the keyway 28. A slot 29 in the bottom of the cylinder 21 communicates with the keyway 28. Thus, when a key (not shown) is inserted into a keyway 28, it moves the pins 26. According to the coding on the key, and the location of the insulating portion 27 on pins 26, one or more of the insulative bands 27 may be moved into alignment with a laterally projecting socket 30 in the housing 22.

Each of the pin sockets 24 has a corresponding lateral socket 30 into which is positioned a conducting ball bearing 31, and a conducting spring 32. As will be explained hereinafter, a resistor 34 may also be interposed between the ball 31 and a conductive retaining screw 33 to provide a variable resistance or output from the lock circuit. If a variable resistance is not desired, the member 34 is not used.

Thus, it is seen that the pins 26 are connected in parallel between the cylinder body 21 and the pin 33, through ball 31 and spring 32. When all of the pins 26 are so positioned that the non-conducting bands 27 are aligned with the lateral sockets 30, the circuit through the lock is interrupted; but so long as one pin does not have its non-conducting band 27 so aligned, the circuit is completed between the cylinder body 21 and pin 33.

The pin 33 is positioned in an insulated tube 33a in an opening 35 through the cylinder extension 19 and extends into the compartment 12a where it contacts a spring contact member 36 and is connected into the time delay circuit. The conductive cover 18 engages a conductive connection 37 on the back wall of the compartment 12a to connect the body of the cylinder assembly into the time delay circuit.

Alternating current connections 38 and 39 extend through the back wall of the housing compartment 12a and are connected to a standard transformer so as to provide the lock with sufficient volts AC. The connection 38 connects through the conductor 37 to the cover 18, while the connection 39 connects through the conductor 40 to the latch. A post 41 is connected through a conductor 42 to the spring contact 36. This is shown in FIG. 7.

A lock series resistance 43 is connected between the post 39 and 41 and thus is in series with the resistances 34 of the lock cylinder (FIG. 7). The supply voltage is connected to the end lead of the series elements, resistances 34 and 43. The control voltage to the time delay circuitry is taken from the voltage across resistor 34. That is, it is taken from connections 41 and 38, to the time delay through conductors "x" and "y," respectively. Therefore, according to the values of resistance 43 and the supply voltage, the voltage across the time delay circuit is varied depending on the value of the lock resistances 34 connected into the circuit by the particular key selected. Thus, a voltage variable time delay to control latch 13 is possible. This voltage may also allow one to identify the particular key which is inserted into the lock. The readout circuit, shown in FIG. 11 and hereinafter described in detail, is used for this.

To describe the variable time delay circuit shown in FIGS. 7 and 8, the spring contact 36 is connected with a diode 44 through the conductor "x." The diode is in series with a resistor 45 and a condenser 46, as well as the first silicon control rectifier (SCR) 47. The positive side of the condenser 46 is connected to the anode of the SCR 47.

A resistor 48 connects the gate of the SCR 47 to the resistor 45 and the condenser 46. The cathode of the SCR 47 is connected to the gate of a second SCR 49 and also is connected to the negative side of the condenser 46 by a resistor 50. The cathode of the SCR 49 also is connected to the resistor 50 and through the resistor 50 to the negative side of the condenser 46. The anode of the SCR 49 is connected to the latch coil 17.

SECURITY STRONG POINTS OF THE LOCK

Since the lock is normally closed and will only open a door upon insertion of the proper key (the key that

opens up the circuit within the lock), drilling into the lock will defeat the purpose of opening the lock, as the act of drilling would only permanently short the interiors of the lock and thus make it more difficult to enter.

A time delay feature is added to the lock to make it nearly impossible for one to pick the lock. This advantage is needed for top security, as, although one cannot properly locate the pins by touch, without the time delay it is possible to randomly and instantaneously properly locate the pins within the lock. But the addition of a time delay circuit to the lock does not allow this, as there is no way of holding the proper combination for the duration of the time delay without the knowledge of what the proper combination is.

In a complex key identification system as few as two or three pins or as many as the total number of pins in the lock can be made to identify a particular key. To assure the same security on both of these extremes, the time delay factor changes. Since the possibility of randomly correctly locating all six pins is far less than the possibility of randomly correctly locating three pins, the time delay would be far greater in the latter case, thus making the chances of randomly opening the lock in either fashion very small.

To allow one to know when a key is left in a door, without the disturbing AC hum of a conventional latch system, a pulsating operation of the latch is incorporated into the time delay circuit.

OPERATION

The supply voltage is connected across the two resistors 34 and 43 in series. As the cylinder resistance 34 varies, the voltage across the lock resistance 34 will vary in the same manner. Thus, if the lock resistance 34 is 0, the voltage across the lock is 0, and if the lock were to open, the voltage across the lock would be the supply voltage. This AC voltage is rectified by the diode 44 and is taken to the capacitor 46 through the resistor 45. The negative lead of the capacitor 46 is connected to the alternating current through the conductor "y," and this is the same lead to which the cylinder resistor 34 is connected. Thus, when voltage is across the lock resistance 34, the capacitor 46 will charge up in a time determined by the resistor 45 and the capacitor 46 and the voltage across the lock. The voltage across the capacitor 46 is applied to the gate of the SCR 47 through a resistor 48. The current through the gate returns from the cathode of the SCR through a resistance 50 to the common negative lead of the capacitor 46. Thus, if the voltage across the capacitor 46 has reached a sufficient level, the SCR 47 will trigger and allow the charge on the capacitor 46, of which the positive lead is hooked to the anode of the SCR 47, to flow through the SCR 47 into the gate of the SCR 49 and out of the cathode of the SCR 49 to the negative lead of the capacitor 46, thus triggering the SCR 49 and allowing a large amount of current to flow through the latch coil 17 and the SCR 49 in series. However, the voltage across the capacitor 46 is quickly lowered now that it is allowed to drain directly through the resistance 50, which is connected across the gate to the cathode of the SCR 49, so that after a few cycles of alternating current through the SCR 49 there is insufficient current through the SCR 49 to allow it to continue current through the latch 17. At the same time that the voltage drops across the SCR 49, the current also is reduced to a sufficient level that the SCR 47 no longer remains conductive. Thus, its opening up allows the capacitor 46 to again charge up (at a time determined by the capacitor 46, the resistance 45 and the voltage across the lock) to a sufficient level to repeat the cycle of triggering the two SCR's. This process of voltage building up, triggering the SCR's, decreasing the voltage to an insufficient level to keep it triggered, and then building up, and triggering it again, is referred to as a relaxation oscillator.

The time of the oscillator is varied by different voltages across the resistor 45 and the capacitor 46 circuit, and thus is varied by the lock resistance 34 itself, so that if the lock were to have no voltage across it or have 0 resistance, the oscillator time delay would be infinite and the latch would not be allowed to open. The circuit is protected against increased supply voltage from triggering it by virtue of the fact that when the key is removed from the lock, the lock resistance is 0, and thus the voltage is still 0 across it, regardless of the supply voltage.

EXAMPLE

A preferred structure of the type shown in FIGS. 7 and 8 has a resistor 43 of 4.7K ohms; a capacitor 46 of 30 mfd.; a resistor 45 of 3.9K ohms; a resistor 48 of 300K ohms; a diode 44 of 1 amp, 50 volt; an SCR 47 of 20 microamp triggering current, 1.6 amp, 100 volt; an SCR 49 of 200 microamp triggering current, 1.6 amp, 100 volt; and a resistor 50 of 1K ohms.

The lock resistance 34 is variable and depending only on the value and number of resistors 34 placed in the lock. In this example, three of the numbers 34 are solid conductive bars so that only three resistances 34 are in the circuit. The values of these three resistances are 6.8K ohms, 4.7K ohms, and 3.3K ohms. The resistances between the common connector 33 and the conductive housing 21 can take on values calculated as follows:

If any of the three horizontal assemblies without the resistors in them (having the solid conductive bars instead) were to be left conductive by virtue of that pin being located off the non-conducting ring, the resistance between pin 33 and the conductive housing 21 is zero. However, after these three pins are displaced so that their non-conductive rings are lined up with the horizontal holes, then remaining in the circuit are three resistors connected in parallel having a total paralleled value now of 1.5K ohms. If only the 6.8K ohms resistor is dropped out of the circuit by proper location of its corresponding pin, the resistance is increased to 2.0K ohms. Removal of only the center 4.7K ohms resistor increases the resistance to 2.2K ohms. Removal of only the 3.3K ohms resistor increases the value to 2.7K ohms. Likewise, removal of both the 6.8K ohms and the 4.7K ohms resistors leaves a resistance of 3.3K ohms in the circuit. Removal of both the 6.8K ohms and the 3.3K ohms resistors leaves a resistance of 4.7K ohms in the circuit. Removal of the 4.7K ohms and the 3.3K ohms resistors leaves a resistance of 6.8K ohms in the circuit. Removal of all the resistors from the circuit (with the three direct contacts also removed) leaves an infinite resistance between the housing 21 and the common conductive pin 33.

Thus, by choosing one of the nine possibilities given, the resistance 34 between the housing 21 and the common pin 33 may vary in value from infinity to zero depending on the values and the quantity of resistors inserted into the circuit. This resistance is referred to as resistor 34 being a varying resistor located within the lock.

Resistor 34 is connected in series with a lock series resistor 43 and across this series combination an AC supply is connected, so that depending on the value of the series resistor 43 and the voltage of the power supply, the voltage across the lock resistance 34 will vary in the following manner. When the lock resistance takes on a value of 0 ohms resistance, no voltage will appear across the lock resistance 34, if the lock resistance takes on an infinite value, the voltage across the lock will be equal to the supply voltage. Voltage across any resistance in between these values will be determined by the following formula. The supply voltage times the lock resistance 34 divided by the sum of the lock resistance 34 and the lock series resistor 43. This voltage across the lock resistance may be used in controlling both the variable time delay and the key identification hereinafter described.

MODIFICATIONS

FIG. 9 shows a non-pulsating circuit which does not have a variable time delay and, accordingly, does not have resistance 34 in the lock cylinders but has a direct connection between the connector bar 33 and the cylinder pins 26. This circuit comprises an AC supply in series with a latch and a rectifying diode bridge having a silicon controlled rectifier 51 thereacross. When the DC output of the bridge is shorted together, the latch 17 is opened. Serving the function of closing the DC output of the bridge is the SCR 51 with its anode going to the positive output of the bridge and its cathode going to the negative output. If sufficient voltage is applied from the gate to the cathode, the SCR 51 triggers and turns on the latch 17.

In this modification the lock 52 is in parallel with the condenser 60 and is normally closed so that current flows therethrough and does not charge the capacitor 60. Accordingly, current through the system start at contact 53 flows through the diode 54, the resistor 55, the lock 52, the diode 56, and the latch 57. This current does not flow through the gate and out the anode of SCR 51, and thus, does not activate the coils and release the latch 57.

When a key is inserted into the lock 52, the lock circuit opens as all of the conductive portions 27 are aligned with the lateral sockets 30. When this occurs, the current flow in the circuit passes from the contact 53 through the diode 54, the resistor 55, across the capacitor 60; and when the capacitor charges up to a sufficient voltage, in a time determined by resistor 55 and capacitor 60, sufficient current flows through the gate 61 of the SCR 51 to trigger SCR 51 so that a large amount of current passes from the anode of the SCR to the cathode and through the diode bridge and the latch 57. This avalanche of the current energizes the coils of the latch 57 so that it opens.

Removal of the key from the lock immediately shorts out the capacitor 60 and thus removes the voltage that was triggering the SCR 51 and allows the SCR 51 to reset as soon as the voltage across it normally reaches 0.

The second modification is shown in FIG. 10 and comprises a normally open lock 61. In other words, the cylinder pins on the lock 61 are insulated and have a conducting band similar to the pins shown in co-pending application Ser. No. 499,674. When a key is inserted into the lock 61, the conductive portions of the pins are aligned with the lateral sockets and current can flow through the lock. As may be seen from FIG. 10, when the lock 61 is open, no current flows and when the lock is closed, current passes from the contact 62 through the diode 63, the resistor 64, the lock 61, and charges up the capacitor 65. When the capacitor 65 charges up to a sufficient voltage, in a time determined by resistor 64 and capacitor 65, sufficient current flows through SCR 66 to trigger it, and allows a large amount of current to pass through the diode bridge (63 and 67, or 69 and 70), and the latch coil 68 to energize the latch coil 68 and open the latch.

The SCR is a type of controlled avalanche rectifier which is the type of device used in all of the modifications of this invention to trigger the latch mechanism.

KEY IDENTIFICATION SYSTEM

FIG. 10 shows a circuit for identifying keys which are inserted into the key slot of the lock of FIGS. 7 and 8. This identification is achieved by balancing resistances against the resistance of the particular resistors 34 which are inserted into the circuit by the different keys.

FIG. 11 shows only three stages of a key identifying circuit. 100, 101, 102 and 104 are connections to the next stage of the circuit and 103 is part of the display tube. 129, 128, 127 are connections to the latching circuitry and also serve as power input to the key identification circuitry. 126, 125 and 124 are connections to the latch circuitry. The voltage between 129 and 127 is con-

nected across the primary 123 of the stepup transformer. The voltage at the secondary 122 of this transformer is connected to a bridge diode network 118, 119, 120 and 121. The output of this network is used to power the display tube 103 through a series resistor 117. The voltage at the output of the diode network is also connected across the bias control 130. The voltage at the slider 131 of the bias control 130 is fed to the biasing network of each stage, the biasing network being made up of resistors 74 and 75 and a capacitor 77. This biasing network applies positive bias to the display tube drivers or SCR 76; while any voltage at the junction of the resistors 72 and 71 tends to supply, through the diode 73, negative bias voltage to the display tube driver. This results in the display tube drive for each stage being biased off until the voltage at the junction of the resistors 72 and 73, for that stage, is zeroed.

From the output of the voltage divider circuit (FIGS. 7 and 8) consisting of the cylinder resistance 34 and the lock series resistance 43, are three wires (two are power supply leads and the other is the center tap of the divider). These three wires lead to a key identification system whereby the two resistors in the divider system act as two of the legs of a Wheatstone bridge. The other half of the bridge consists of eight (8) (eight being the most practical number of stages for this design) separate elements. Each element is made up of a resistor 71 of the same value as the lock series resistor 43 and a resistor 72 which varies from stage to stage. For each resistance that the pins may take 34 (determined by the particular key inserted) there is an equal resistance in each of the eight (8) elements or resistors 72. Therefore, there are eight different values for resistor 71 and a different value for each stage. The output of each stage is taken from the junction of resistors 71 and 72; the common connection of the output being the junction of the cylinder resistance 34 and the lock series resistance 43. When the resistance of the lock is equal to resistance 72 of a particular stage, the output of that stage drops to zero because the Wheatstone bridge for that stage is balanced.

Each indicator light of a neon readout (nixie) is controlled by an SCR. Each SCR is supplied with "on bias" to the gate lead, which tends to turn on the SCR and its related indicator. The output of each stage is rectified and applied to the gate lead of the SCR in order to counter the "on bias." When a stage output is zero, the "on bias" is not countered and is therefore allowed to trigger the SCR and light up a particular number of a neon readout indicator. All the other stages are held off by the unbalanced bridges which counter the "on bias" to the remaining SCR's.

MASTERING

While a standard lock may be mastered basically only by placing more than one split in the pins and thus limiting its mastering levels due to a factor of cross combination, the lock of the present invention may be mastered not only by placing additional rings on the pins, but by setting up systems whereby the number of pins correctly located within the lock will also play a factor in whether the lock may be opened. By using such a method on a seven pin lock whereby the lock will open if either four pins are properly located or if all seven pins are properly located, it is possible to achieve (using only one side of the lock) a mastered system which would contain 10 levels of mastering and

$$\left(9^3 \times \frac{7 \cdot 6 \cdot 5 \cdot 4}{4 \cdot 3 \cdot 2 \cdot 1}\right)$$

or 25515 individual locks on the bottom level.

While a conventional lock is limited in its mastering abilities due to cross combinations within the lock, by making use of the fact that in the present electric lock one can identify the number of pins properly located within the lock, it is possible to come up with a mastering system as follows.

THE 7-4 MASTERING SYSTEM

By making the latch operate when either all seven pins of a seven pin lock are correctly located or if any set of four pins are correctly located, one can master a system as follows. This is based on the circuit and structure shown in FIGS. 1-8 in which all of the resistances 34 in the lock are of the same value for purposes explained hereinafter and there are seven pin assemblies in the lock. Also, the basic circuit of FIGS. 7 and 8 are varied slightly as shown in FIG. 10 and explained hereinafter.

With a given master combination, which I will refer to as combination A, B, C, D, E, F, G, many sets of four letter combinations may be chosen, such as A, C, D and G, with the remaining three combinations being any other combination other than that of the master combination (of which there are nine per pin, assuming there are ten possible locations of the conducting ring 27 for each pin 26). Thus, if an individual lock will open if either seven or four pins are properly located, and if an individual lock contains four of the master key's combination and three of its own, there would then be

$$\frac{7 \cdot 7 \cdot 5 \cdot 4 \cdot 3}{4 \cdot 3 \cdot 2 \cdot 1}$$

times 9^3 different individual locks which could be opened by the master key. Each individual lock will have for its individual key a key that correctly locates all seven pins within the lock. By doing this, the individual key of a particular lock will not be able to open up any other lock. However, the master key, which only correctly locates four pins in each individual lock, is able to open up all the individual locks.

In such a system one could achieve up to ten levels of master by making keys which have either 4, 5, 6 or 7 letters of the seven digits combination of the master key. The system has the advantage over the conventional mastered system in that it has more available mastering levels. It also has a greater number of individual keys, due to the fact that the cross combinations in such a mastered electric lock are far below that of the conventional mastered system with three splits per pin.

In addition, it has the advantage that the removal of any lock from a given master system does not allow the remover to have access to the master combination. Instead a large quantity of locks has to be removed before one can correctly limit the master combination. In a conventional mastered system, the removal of only one lock and its key out of a system gives access to the master combination.

To assure that one cannot detect which four pins of the seven pins in a lock are of the master combination, it is important that an equal value resistor 34 be placed in series between the pins 26 and the common conducting bar 33 of each of the seven pin assemblies. By doing this, the resistance of the lock will be the same, regardless of what set of four pins are correctly located. Thus, one could not tell by examination of the lock which set of four pins are of the master combination, as any set of four pins correctly located will open the lock.

KEY IDENTIFICATION OF THE 7-4 MASTERING SYSTEM

Using the basic variable pulsating time delay circuit of FIGS. 7 and 8, one can make an identification system that will trigger the time delay circuit only upon insertion of keys that properly locate all seven pins, or keys that properly locate any set of four pins, as needed in the 7-4 mastering system. To do this, the following changes should be made in the circuit of FIG. 8, and this results in the circuit shown in FIG. 12. A third SCR 75 is added to the circuit with its anode connected to the junction of the diode 44 and resistor 45 and its cathode going through a resistor 76 to the junction of the lock resistance 34 and the lock series resistor 43. Connected across the AC supply are two resistors in series. The first resistor 34a is of

the same value as the resistance of the lock when any four pins within it are correctly located. The other resistor 43a is the same value as the lock series resistance. From the junction of these two resistors (resistor 34a and lock series resistor 43a), a lead runs to the gate of SCR No. 3. 5

CIRCUIT FUNCTION

Making up a Wheatstone bridge are four resistors: lock resistor 34, lock series resistor 43 making one leg of the bridge; resistor 34a and resistor 43a making the other leg. 10 The input of the bridge is the AC power supply. The output of this bridge goes through the resistor 76 to the cathode of the SCR 75 and from the gate of the SCR 75 to the junction of resistor 34a and resistor 43a, so that when the lock resistance 34 takes on any value other than the resistance of resistor 34a, the SCR 75 will be triggered to the "on" state due to the bridge being unbalanced. The triggering of the SCR 75 will tend to discharge the capacitor 46 through the resistor 45, and the resistor 76. However, 15 this rate of discharging the capacitor 46 will not be as great as the rate of charging through diode 44 if the voltage across the lock is at its maximum value, i.e., the supply voltage. Thus, when full supply voltage appears across the lock resistor 34, the capacitor 46 is still allowed to charge and operate the time delay circuit. However; any other value that the lock resistance may take will not allow the time delay circuit to function because the capacitor 46 will not be allowed to charge, since it will be discharged through the SCR 75. The exception to this is that when the lock resistance takes on the same value as the resistor 34a. In such a case, the output of the Wheatstone bridge (made up of resistors 34, 43, 34a and 43a) is of insufficient voltage to trigger the SCR 75. Consequently, the voltage across the lock resistance 34 is sufficient to allow the capacitor 46 to charge up as the SCR 75 is no longer discharging it through the resistor 76. 20 25 30 35

In this circuit, the change in the voltage across the lock resistance, due to the changes in resistance of the lock from the time when all the pins of the lock are correctly located and when all but one pin in the lock is correctly 40 located, must be of sufficient variance so that the latter does not also trigger the time delay circuit.

USE OF BOTH SIDES OF THE LOCK TO INCREASE THE POSSIBLE PATTERNS PER INDIVIDUAL SET OF PINS USED

For both identification and mastering purposes, it may be found necessary to use both sides of the lock in the same manner that one side of the lock has previously been used. In such a system where both sides of the lock are used, the horizontal contact holes are located at varying heights rather than one given location. In such a system the insulative ring on the pin in any given assembly is either located at the level of the right horizontal hole, the left horizontal hole, or neither. Thus, in such an assembly there are three functioning locations of each individual pin. Thus making a total of three to the power of the number of pins used possible identifiable combinations per given set of ring heights.

This invention is intended to cover all changes and modifications of the examples of the invention herein chosen for purposes of the disclosure, which do not constitute departures from the spirit and scope of the invention.

What is claimed is:

1. A latch release time delay circuit comprising:

- (a) an alternating current power source,
- (b) electrically releasable latch means,
- (c) lock means connected to the power source,
- (d) voltage discharge means of the controlled avalanche variety connected to the latch and lock means, and comprising 70
- (i) a rectifying bridge connected across the alternating power source and having its direct current terminals in series with the latch means so 75

that the direct current discharged therefrom will actuate the latch means,

- (ii) a resistance in series with the lock,
- (iii) a silicon controlled rectifier having the lock connected between its gate and anode, and
- (iv) a capacitance connected between the gate and the cathode of the silicon controlled rectifier,

said lock normally interrupting the circuit but closing the circuit when a key is inserted therein to permit charging of the capacitance and the discharge from the capacitance to fire the SCR and open the latch in a given time determined by resistance and capacitance.

2. A latch release time delay circuit comprising:

- (a) an electrical power source,
- (b) electrically releasable latch means,
- (c) lock means connected to the power source, and including
- (i) a plurality of resistances connected in parallel,
- (d) a R-C circuit parallel connected to the plurality of resistances to supply a voltage across the plurality of resistances contained in the lock,
- (e) a first silicon controlled rectifier having the R-C circuit connected across its gate and anode, and
- (f) a second silicon controlled rectifier having its gate connected to the anode of the first SCR,

whereby the capacitor in the R-C circuit charges and then discharges through the first SCR, thereby triggering the first SCR and discharging to the gate of the second SCR so as to trigger the second SCR and energize the latch, the SCR's thereafter reverting to their original states so as to form a pulsating action of the latch.

3. The circuit of claim 2 including a third SCR having its anode connected to the resistance capacitance circuit and its cathode is connected between the first and second resistances, and including a lead from the gate connected between a third resistance equal to the first resistance and a fourth resistance equal to the value of a preselected number of the parallel resistors in the lock connected in parallel in the circuit.

4. The circuit of claim 3 wherein seven resistors form the second lock resistance and all of the resistors are of the same value, and the fourth resistance is equal to the value of four of the resistors parallel connected.

5. The circuit of claim 2 including a stage key identification circuit connected across the first and second resistances with a third lead between the first and second resistances, the key identification circuit including a series of elements each of which includes a first resistance equal in value to the first lock resistance and a second varying resistance equal in value to the different value which the second lock resistance may take, so that the output from a particular stage is zero when the second lock resistance is equal to the second element resistance, including an SCR for each stage which is fired when the said stage output is zero to activate an indicator device.

6. An electric lock device comprising:

- (a) an electrically insulated housing,
- (b) a non-rotatable key slot provided in the housing,
- (c) at least one movable electrically conductive tumbler pin mounted in the housing and projecting into the key slot,
- (d) resilient means urging the pin toward the key slot, said pin being movable by a key inserted in the key slot, said pin having an electrically insulating portion on the outer surface thereof,
- (e) an electrical contact member aligned with and engaging the pin,
- (f) said pin and said electrical contact member normally being electrically connected, said circuit being interrupted when a key is inserted in the slot to move the electrically insulating portions of the pin into alignment with the contact member.

7. The structure of claim 6 including a diode rectifying bridge electrically connected across an alternating current voltage source in series with a latch controlled by the lock

11

device and voltage supply means controlled by the lock for shorting the voltage from the bridge to open the latch when a key is inserted into the lock to interrupt the current through the lock.

8. The structure of claim 6 including

- (a) a plurality of pins,
- (b) a conducting cylinder into which the insulating housing is positioned, the pins being electrically connected to the cylinder,
- (c) the electrical contact member being positioned within the insulative housing, and
- (d) a common connection for the electrical contact members to connect the pins electrically in parallel.

9. The structure of claim 8 wherein the cylinder is provided with a slot terminating on the circumference and connected to the key slot in the insulating housing.

10. The structure of claim 6 including a time delay circuit controlled by the lock device and connected to a electrically controlled latch means and a voltage source to free the latch means a predetermined time after the key is inserted into the key slot.

11. The structure of claim 8 including resistor means in the connections between the pins and the common connection.

12. The structure of claim 11 wherein the resistors are of varying sizes.

13. The structure of claim 11 wherein the resistors are of the same size.

14. The structure of claim 6 including a second electrical contact member aligned with and engaging the pin and in a direction opposed to the first electrical contact member.

15. The structure of claim 12 including a key identification device triggered by the value of the lock resistance.

16. The structure of claim 13 including seven pins and wherein any four or all seven of the pins, when disconnected from the lock circuit, will energize the latch.

17. A security system comprising a controlled section, a controlling section capable of accepting a code, and a pulsating electronic time delay between the controlling and controlled sections for preventing the controlled section from functioning during any short period of time during which the code to the system is experimentally applied.

18. A security system according to claim 17 wherein the electronic time delay causes the controlled section to function during such time that the code to the system is properly applied.

19. A security system according to claim 17 wherein the electronic time delay includes a time-delayed relaxation oscillator.

20. A security system according to claim 19 wherein the time-delayed relaxation oscillator causes the controlled section of the system to pulse "on" during such time that the code to the system is properly applied.

12

21. A security system comprising a controlled section, a controlling section capable of accepting a plurality of codes and having a plurality of elements for sensing the presence of the codes, each sensing element altering a circuit through the controlling section when a correct code is applied to it but leaving the circuit in its normal condition when no code or an improper code is applied to it, and a code-dependent variable time delay connected between the controlling and controlled sections for operating the controlled section when a correct code is applied to the elements of the controlling section and for preventing the controlled section from operating during a short increment of time during which any incorrect code to the system are experimentally applied, the code-dependent time delay increasing as the complexity of the code decreases, thus maintaining the security of the system

22. A security system according to claim 21 wherein the variable time delay includes a code-dependent variable relaxation oscillator.

23. A security system according to claim 22 wherein the code-dependent variable relaxation oscillator causes the controlled section of the system to function during such time that the code to the system is properly applied.

24. A security system according to claim 21 wherein each sensing element interrupts a circuit through a resistance when the correct code is applied to it but completes the circuit through the resistance when no code or an improper code is applied to it.

25. A security system according to claim 21 wherein the code-dependent variable time delay operates the controlled section when groups of elements constituting less than all of the elements are placed in circuit altering condition as well as when all of the elements are placed in circuit altering condition, and wherein the time delay is greater for codes which place fewer elements in circuit altering condition than for codes which place more elements in circuit altering condition so that the time delay increases as the complexity of the code decreases.

26. A security system according to claim 25 wherein each element is a dielectric pin having an electrically conductive band on it, and wherein the pins are fitted into bores which intersect a keyway.

References Cited

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