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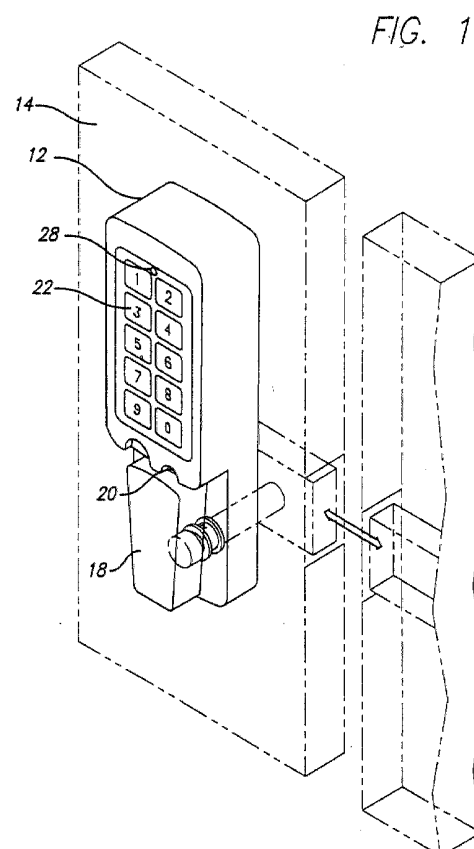
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(54) **Electromechanical lock with different sequences of operation in relation to keying in different access codes**

(57) A battery-powered, electromechanical lock and method of actuating the lock. When the battery is low, the lock is activated and the system signals the low battery. When an invalid access code is keyed in, after a predetermined number of times a penalty sequence applies, and after an invalid access code is again keyed in, the penalty is reapplied. This system can have multiple user codes which are valid.



Description

RELATED APPLICATION

[0001] This application relates to the european patent application of the present Applicant being filed coterminously with the present application. Such application is entitled "COMBINATION LOCK WITH TERMINALS OR OPERATION WITHIN AN ADDITIONAL BATTERY", european patent application No.

[0002] The contents of that application are incorporated by reference herein.

BACKGROUND OF THE INVENTION

[0003] This invention relates to electromechanical locks, a method of actuating such a lock on a system for such lock actuation. More particularly, the invention is concerned with a battery-powered lock where different access codes can be applied and where the system changes according to the level of the battery voltage.

[0004] Many kinds of electromechanical locks and locking mechanisms are known. Different systems are known for indicating when a battery voltage level falls below a predetermined level. The present invention is directed to providing an improved system for indicating a low-battery voltage.

[0005] Moreover, such locks do often require disablement or the like if an incorrect access code is used. This invention is directed to providing an improved system of operation wherein an incorrect access code is used.

SUMMARY OF THE INVENTION

[0006] This invention has as an object the provision of a new and improved battery-powered electromechanical lock method and system for signaling the condition of a low battery voltage, and further for introducing a penalty sequence wherein an incorrect access code more than a predetermined number of times.

[0007] This is achieved by carrying out the features disclosed in the main claims. The dependent claims outline preferred forms of embodiment of the invention.

[0008] According to the invention as provided, an electromechanical lock with a circuit is responsive to a lock actuation signal to actuate a locking mechanism mechanically between an open and closed position.

[0009] There is a microprocessor coupled to the driver circuit to respond to access codes keyed into the lock. If an incorrect access code is keyed in more than a predetermined number of times, preferably five, a penalty sequence is applied. Such sequence would be the activation of indication means, for instance the flashing of an LED, for a predetermined time period. After that, if an invalid access code is keyed in, a second penalty sequence is applied. Such penalty sequence can be applied after the invalid code is attempted more than a predetermined number of times. The penalty sequence can

also be the indication of LED flashing for a predetermined period of time.

[0010] A further aspect of the invention includes signaling low battery voltage. This is preferably effected when a correct access code is entered and preferably after activating the locking mechanism. In a preferred form of the invention, the low battery signal is activated in this situation each time the lock is activated. Such signal is preferably an LED, which emits multiple flashes for a predetermined period of time.

[0011] The invention is further described with reference to the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

[0012]

Figure 1 is a representation of a lock with an input keypad, a pistol grip, and a locking mechanism for movement in relation to a door and a door jamb.

Figure 2 is a diagrammatic block schematic of a battery-powered electromechanical lock.

Figure 3 is a representation of the algorithmic sequence for a user changing the access code.

Figure 4 is a representation of the algorithmic sequence for activating the lock by keying in a valid code or an invalid code, and the application of the consequent penalty.

Figure 5 is a algorithmic sequence representation of the lock showing the system for indicating low battery.

DETAILED DESCRIPTION OF A PREFERRED EMBODIMENT

[0013] In Figures 1 and 2, there is shown a representation of a battery-powered electromechanical lock where the lock can be accessed under low battery conditions in accordance with the algorithmic sequence described. The battery-powered electromechanical lock 10 comprises a housing 12 which is mounted on one side of a door 14. An electronic logic circuit 20 powered by a battery 24 is mounted within the housing 12. It is responsive to a coded input sequence entered via a keypad 22 mounted to the housing 12. The logic circuit 20 causes a solenoid plunger or latch 16 mounted within the door 14 to move between a closed and open position when a coded input sequence is received via a user entering the correct combination from the keypad 22.

[0014] There is a pistol grip 18 associated with the lock and when this is turned, the door 14 can be opened if the plunger 16 is retracted into the open position. When the plunger 16 is actuated to its open position, the plunger 16 remains retracted for a sufficient period of time to permit the user to open the door 14. Locking of the door 14 can be effected, for instance when the user

re-enters the correct access code to enable the door 14 to once again be locked in the closed position.

[0015] The battery 24, when under low voltage conditions, needs to be replaced. The lock 10 includes a voltage or power-detection circuit 26 which is coupled between the logic circuit 20 and the battery 24. The circuit generates a low battery voltage signal whenever the current output from the battery 24 falls below a predetermined level.

[0016] The logic circuit 20 responds to the low voltage signal and causes a light-emitting diode 28 mounted on the keypad 22 in the housing 12 to be illuminated to give a visual indication that the battery 24 is low.

[0017] The system for indicating when the battery is low is illustrated in Figure 5. After the access code is entered, and the code is correct as indicated by block 60, the lock is activated as indicated by block 62. The battery low signal is indicated in a sequence block 64 and the LED 28 would flash multiple times for a predetermined period, for instance five seconds as indicated by block 66. This technique of indicating the low battery condition is particularly effective since it will be apparent to the user each time the door is opened, because the user is at the lock wherein the signaling is effected. Such signaling will continue until the low battery condition is changed, either by replacement of the battery or by application of an alternative battery source.

[0018] The logic circuit 20 comprises a microprocessor 30 having a read-only memory unit 32 and a random-access memory 34. The memory 32 has at least one combination or authorized access code stored therein to be retrieved for comparison purposes with another access code entered by the user via the keypad 22. In the preferred form of the invention, there are multiple access codes which are valid. Thus, the RAM would store these multiple correct access codes so that multiple different users can use this code. Preferably, there are two access codes which are valid.

[0019] The RAM 34 is coupled between the microprocessor 30 and an external interface unit 36 via a common database 38. The interface 36 can be accessed for downloading the access variation program 100 into the RAM 34.

[0020] The microprocessor 30 controls the operation of the plunger 16. The lock 10 also includes a transistor-type solenoid driver circuit 40 coupled between the microprocessor 30 and solenoid 42. The solenoid 42 causes the plunger to move between open and closed positions when the microprocessor 30 sends an actuation signal to the driver 40. The operation of the solenoid driver 40 and solenoid 42 are well known to those skilled in the art. The driver 40 can be different from the solenoid driver, for instance a motor driver may be employed. The code indicator entry 44 is the light-emitting diode 28 mounted on the keypad 22.

[0021] In the operation mode, the lock 10 is shipped with a user code length which is factory sent and is either four or six digits. The code length is not changeable. The

preferred lock has the LED 28 and has no audible signal means. There are preferably two codes. Thus the lock could be shipped in a preset form with user codes set as 1-1-1-1 (-1-1) and 5-5-5-5(-5-5). This is represented in Figure 3 by block 70.

[0022] To start a process to change the user code, the user enters zero four times, as indicated by block 72. This switches the LED on, as indicated by block 72. The user enters the old code 76. If the old code is invalid 78, the LED is turned off 80 and the system would return to permit the user to enter the zero four times again to repeat the process. Alternatively, after entering the old code if this is valid 82, the LED is on 84. The user then enters the new code twice 84 and the LED interrupts each keystroke to go off/on for each keypad entry 86. After the code length is entered effectively, the LED will be in the on or off position according to the code entered by the user.

[0023] If the code entered by the user starts with a zero (0), the LED would stay on during code entry. If it is any other number, the LED would not be on during the code sequence. The use of the system according to the algorithmic sequence is illustrated in Figure 4. Entering zero as the first entry of the new code 100 causes the LED to be on 102. The LED for each keypad entry 104 switches between the off and on mode 106. If the code is valid 108, the LED double blinks 110 and the LED goes to the off state. If the code is invalid 114, the LED treble blinks 116 and the LED is off 118. This is the first manner by which the user can determine whether the correct code or invalid code has been keyed into the access code system. Namely, whether there is a double blink or a treble blink of the LED indicates this. Where the code is invalid a subsequent sequence is followed which leads to a penalty application sequence.

[0024] Should the first number of the new code not be a zero 120, the LED is off in the normal state 122. If an invalid code is entered 124, the system will be operable and the LED will be off. Alternatively, if the code is invalid 126, there is an opportunity to re-enter the code 128. If a subsequent invalid code 130 is entered, this cycles back and the opportunity is given to re-enter the code up to five times. After attempting to enter the code five times, if the input is invalid five times 132, a penalty sequence 134 applies. This causes the LED to flash every two seconds for five minutes 136. Thereafter, the code entry is permitted. Should the entry be invalid twice 138, a penalty sequence is applied again 140. The penalty sequence is the flashing of the LED every two seconds for five minutes 142.

[0025] This system provides for an effective use of a penalty after attempting to enter invalid codes. It is effective for signaling the user of the invalidity of the codes. The lock system of the present invention provides for effective use. The lock can be applied on safes or in other situations between a door and a door jamb as required. The invention has been described with regard to a preferred embodiment. Many variations and

modifications are possible.

[0026] The invention is to be determined solely by the following claims.

Claims

1. A battery-powered electromechanical lock having a lock mechanism movable between open and closed positions for securing an access entrance, comprising:
 - driver circuit responsive to a lock actuation signal for permitting a lock mechanism to be moved mechanically between an open and closed position;
 - a microprocessor coupled electrically to said driver circuit for generating said lock actuating signal in response to a correct access code;
 - a keypad coupled electrically to said microprocessor for enabling a user to enter an access code, and said access code being received by said microprocessor for comparison purposes to determine whether the user-entered access code is the correct access code;
 - a power detection circuit coupled electrically to the microprocessor for generating a power signal indicative of a battery voltage level condition;
 - an access variation algorithm responsive to said power signal for enabling the microprocessor to generate the lock actuation signal in response to the user and to the correct access code; and
 - another access variation algorithm responsive to the power signal of the battery level for enabling the microprocessor to generate a signal in response to entering the correct access code, the signal indicating the battery voltage low level condition.
2. A lock as claimed in Claim 1 wherein the battery low condition is signaled by multiple flashes after the lock actuation signal is signaled.
3. A lock as claimed in Claim 2 wherein the signal are multiple flashes of a light-emitting source for a predetermined term limit.
4. A battery-powered electromechanical lock having a lock mechanism movable between open and closed positions for securing an access entrance, comprising:
 - driver circuit responsive to a lock actuation signal permitting the locking mechanism to be moved mechanically to between an open and closed position;
 - a microprocessor coupled electrically to said driver circuit for generating said lock actuating signal in response to a correct access code;
 - a keypad coupled electrically to said microprocessor for enabling a user to enter an access code and said access code being received by said microprocessor for comparison purposes to determine whether the user-entered access code is the correct access code; and
 - a microprocessor coupled electrically to said driver circuit for generating said lock actuating signal in response to a correct access code;
 - a keypad coupled electrically to said microprocessor for enabling a user to enter an access code and said access code being received by said microprocessor for comparison purposes to determine whether the user-entered access code is the correct access code; and
 - an access variation algorithm responsive to the keypad for enabling the microprocessor to generate a penalty sequence in response to the user entering the incorrect access code and wherein the penalty sequence is selectively a flashing of a light at a predetermined frequency for a predetermined time period.
5. A lock as claimed in Claim 4 wherein the keying in of an invalid access code repetitively causes the penalty to be applied repetitively for a predetermined number of separate, access code keying, and wherein the penalty sequence applies after the first predetermined number of access code keying.
6. A lock as claimed in Claim 5 wherein after the operation of the penalty sequence the algorithm permits keying in of an access code, and wherein the keying in of an incorrect access code a predetermined number of times reactivates the penalty sequence.
7. A lock as claimed in Claim 6 wherein the predetermined number of times for reactivating the penalty sequence is different from the predetermined number of times for activating the penalty sequence the second time is different from the predetermined number of times of code access entry attempted the first time before activating the first penalty sequence.
8. A battery-powered electromechanical lock having a lock mechanism movable between open and closed positions for securing an access entrance, comprising:
 - driver circuit responsive to a lock actuation signal permitting the locking mechanism to be moved mechanically to between an open and closed position;
 - a microprocessor coupled electrically to said driver circuit for generating said lock actuating signal in response to a correct access code;
 - a keypad coupled electrically to said microprocessor for enabling a user to enter an access code and said access code being received by said microprocessor for comparison purposes to determine whether the user-entered access code is the correct access code; and
 - a microprocessor coupled electrically to said driver circuit for generating said lock actuating signal in response to a correct access code;
 - a keypad coupled electrically to said microprocessor for enabling a user to enter an access code and said access code being received by said microprocessor for comparison purposes to determine whether the user-entered access code is the correct access code; and
 - an access variation algorithm responsive to the keypad for enabling the microprocessor to generate a penalty sequence in response to the user entering the incorrect access code and wherein the penalty sequence is selectively a flashing of a light at a predetermined frequency for a predetermined time period.

- including a sequence whereby a signal can be retained on or off when an access code is keyed in for receipt by the microprocessor, said access code being for comparison purposes to determine whether the user-entered access code is the correct access code. 5
- 9. A lock as claimed in Claim 8 wherein after the entry of the correct access code a signaling device is off when the correct access code is keyed into the microprocessor, such code being compared in the microprocessor to determine whether the user-entered access code is the correct code and in such event the signaling means is off. 10
- 10. A lock as claimed in Claim 9 wherein the signaling means is a visual indicator, such visual indicator selectively being a light-emitting diode. 15
- 11. A lock as claimed in Claim 8 wherein the signaling means is rendered off if the access code keyed in and compared to an access code stored in the microprocessor is either valid or invalid, such off signal occurring after the user has attempted to key in the access code. 20
- 12. A battery-powered electromechanical lock having a lock mechanism movable between open and closed positions for securing an access entrance, comprising 25
 - driver circuit responsive to a lock actuation signal permitting the locking mechanism to be moved mechanically to between an open and closed position; 30
 - a microprocessor coupled electrically to said driver circuit for generating said lock actuating signal in response to a correct access code; 35
 - a keypad coupled electrically to said microprocessor for enabling a user to enter an access code and said access code being received by said microprocessor for comparison purposes to determine whether the user-entered access code is the correct access code; and 40

wherein the microprocessor stores multiple different access codes for permitting the microprocessor to generate a lock actuation signal in response to the user entering any one of the correct access codes. 45
- 13. A lock as claimed in Claim 12 wherein the multiple user access codes include at least two user access codes. 50
- 14. A method for operating a battery-powered electromechanical lock having a lock mechanism movable between open and closed positions for securing an access entrance, comprising
 - causing a lock actuation signal to permit movement between an open and closed position;
 - generating a lock actuating signal in response to a correct access code;
 - keying in an access code and said access code for comparison purposes to determine whether the user-entered access code is the correct access code;
 - detecting a power signal indicative of a battery voltage level condition;
 - enabling a lock actuation signal in response to the user and to the correct access code; and
 - generating a signal in response to entering the correct access code, the signal indicating the battery voltage low level condition.
- 15. A method as claimed in Claim 14 wherein the battery low condition is signaled by multiple flashes after the lock actuation signal is signaled.
- 16. A method as claimed in Claim 15 wherein the signal are multiple flashes of a light-emitting source for a predetermined term limit.
- 17. A method for operating a battery-powered electromechanical lock having a lock mechanism movable between open and closed positions for securing and access entrance, comprising:
 - generating a lock actuation signal to permit opening and closing ;
 - generating said lock actuating signal in response to a correct access code;
 - enabling a user to enter an access code and said access code being for comparison purposes to determine whether the user-entered access code is the correct access code; and
 - generating a penalty sequence in response to the user entering the incorrect access code and wherein the penalty sequence is selectively the flashing of a light at a predetermined frequency for a predetermined time period.
- 18. The method of Claim 17 wherein the keying in of the invalid access code repetitively causes the penalty to be applied repetitively for a predetermined number of separate keys, access code key, and wherein the penalty sequence applies after the first predetermined number of access code keying.
- 19. The method of Claim 18 wherein after the operation of the penalty sequence the algorithm permits keying in of an access code, and wherein the keying in of an incorrect access code a predetermined number of times reactivates the penalty sequence. 55

20. The method of Claim 19 wherein the set predetermined number of times for reactivating the penalty sequence is different from the predetermined number of times for activating the penalty sequence the second time is different from the predetermined number of times of code access entry attempted the first time before activating the first penalty sequence. 5
21. A method for operating a battery-powered electro-mechanical lock having a lock mechanism movable between open and closed positions for securing and access entrance, comprising:
- permitting a locking mechanism to be moved mechanically to between an open and closed position; 15
 - generating a lock actuating signal in response to a correct access code;
 - enabling a user to enter an access code and said access code for comparison purposes to determine whether the user-entered access code is the correct access code; including a sequence whereby a signal can be retained on or off when an access code is keyed in, said access code being for comparison purposes to determine whether the user-entered access code is the correct access code. 20 25
22. The method of Claim 21 wherein after the entry of the correct access code a signaling device is off when the correct access code is keyed into the microprocessor, such code being compared in the microprocessor to determine whether the user-entered access code is the correct code and in such event the signaling means is off. 30 35
23. The method of Claim 22 wherein the signaling means is a visual indicator, such visual indicator selectively being a light-emitting diode. 40
24. The method of Claim 22 wherein the signaling means is rendered off if the access code keyed in and compared to an access code stored in the microprocessor is either valid or invalid, such off signal occurring after the user has attempted to key in the access code. 45
25. A method for operating a battery-powered electro-mechanical lock having a lock mechanism movable between open and closed positions for securing and access entrance, comprising 50
- generating a lock actuation signal to permit a locking mechanism to be moved between an open and closed position; 55
 - generating an actuating signal in response to a correct access code;
- enabling a user to enter an access code and said access code for comparison purposes to determine whether the user-entered access code is the correct access code; and
 - storing multiple different access codes for permitting generation of a lock actuation signal in response to the user entering any one of the correct access codes.
26. The method of Claim 25 wherein the multiple user access codes include at least two user access codes.

FIG. 1

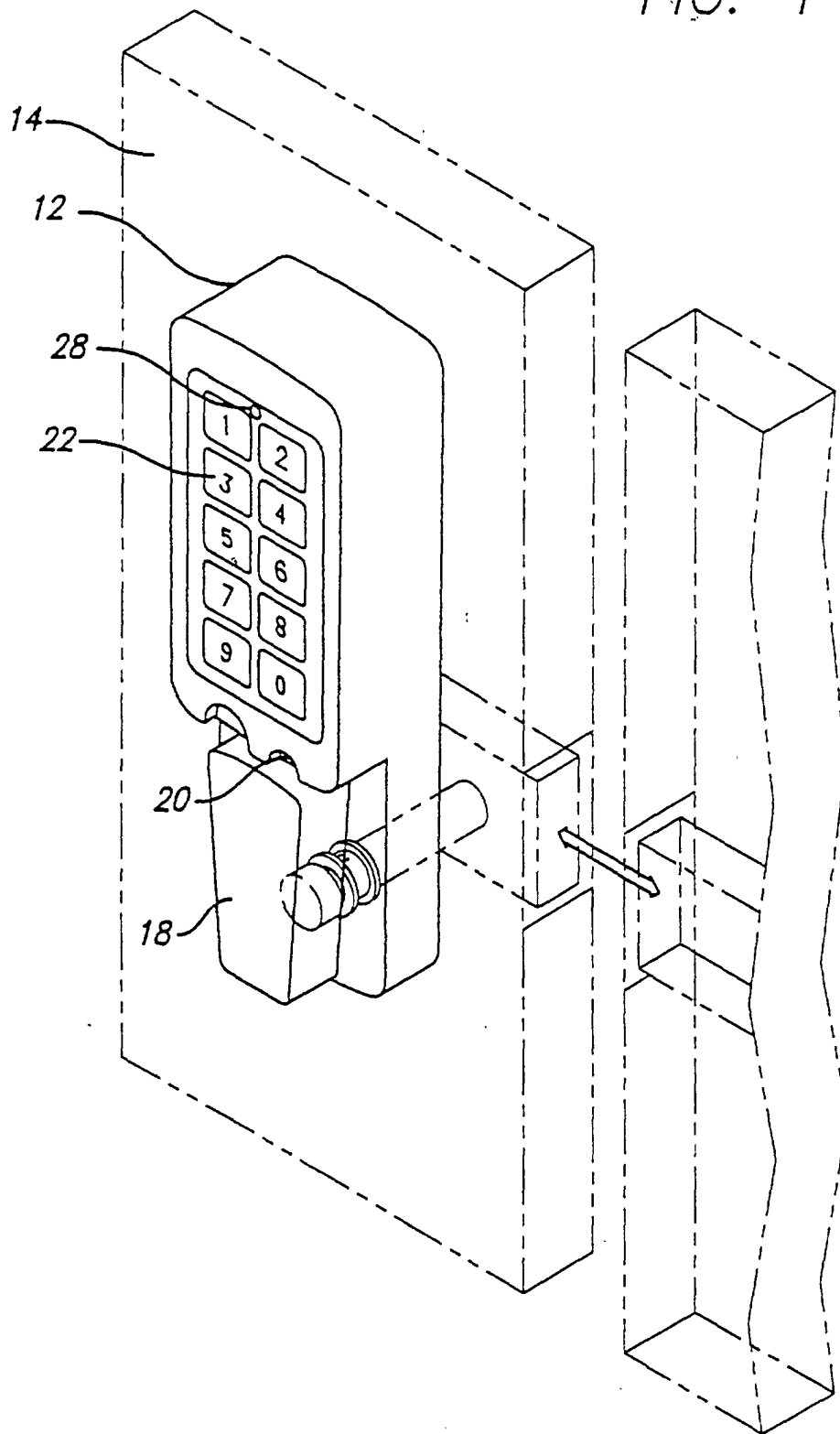


FIG. 2

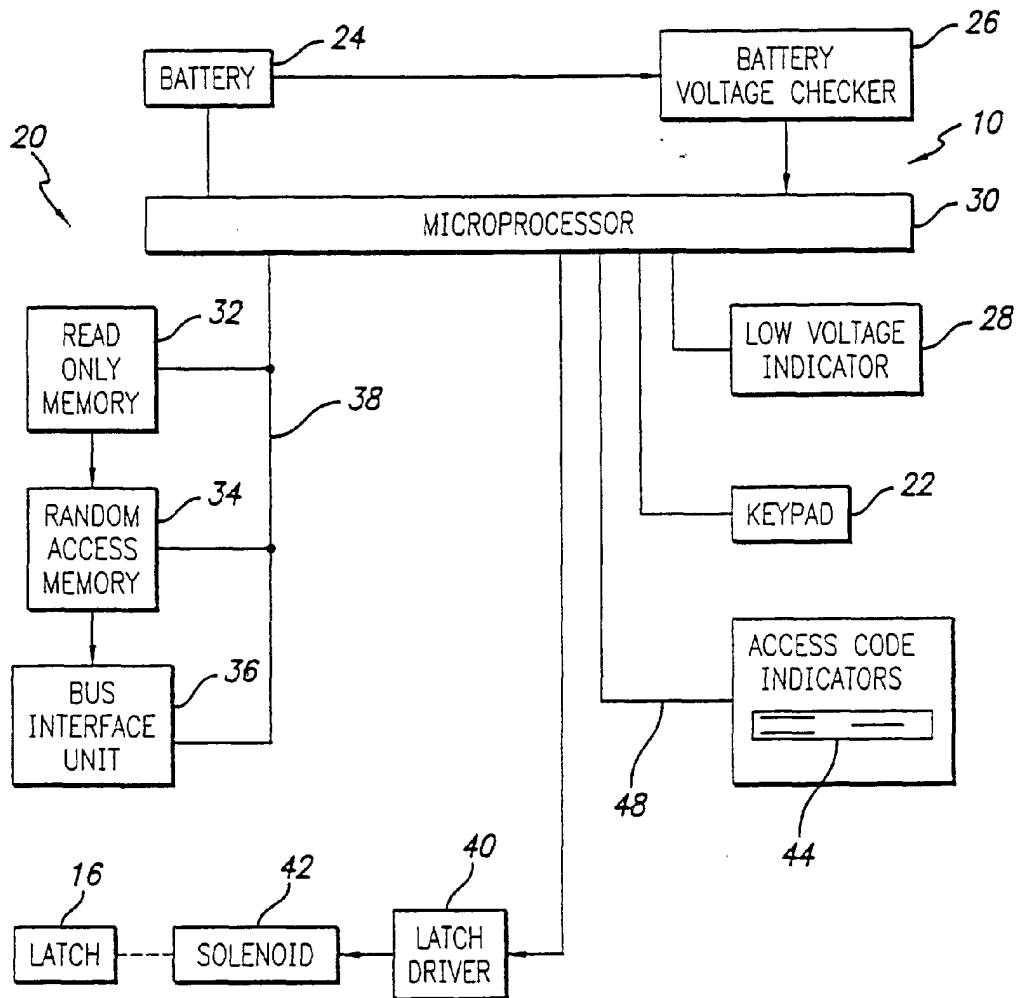


FIG. 5

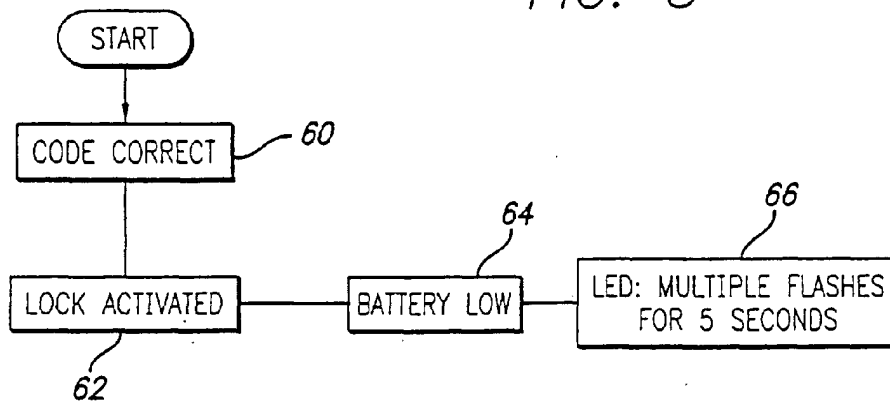


FIG. 3

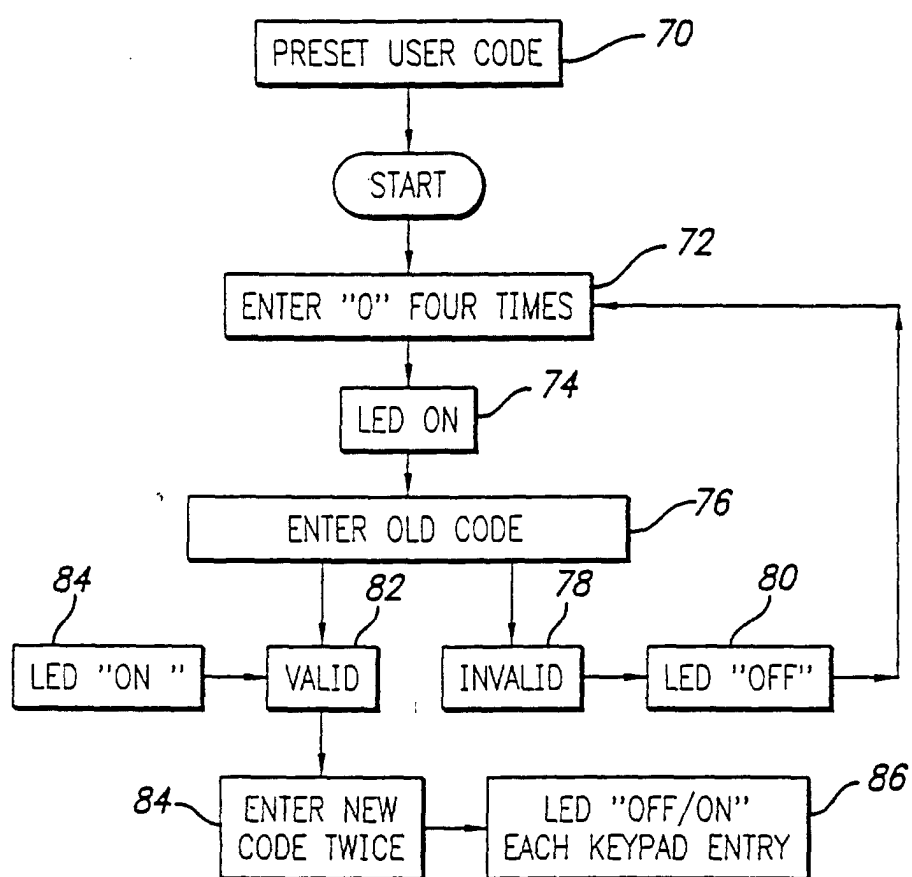
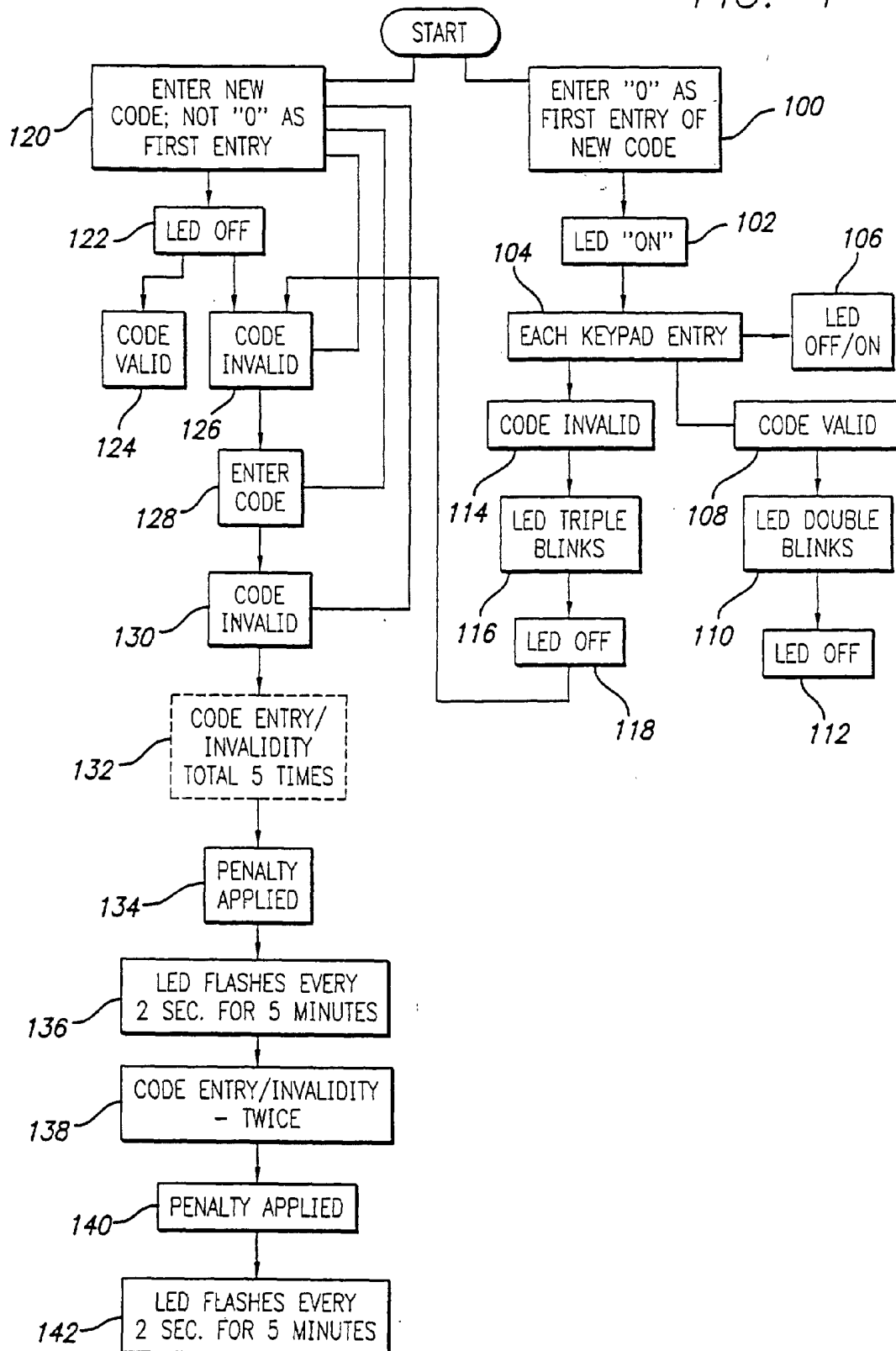


FIG. 4





European Patent
Office

EUROPEAN SEARCH REPORT

Application Number
EP 00 12 0978

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.7)
X	US 5 867 107 A (GARTNER KLAUS W) 2 February 1999 (1999-02-02)	1-3, 8-11, 14-16, 21-24	E05B49/00 E05B47/00
Y	* abstract * * column 2, line 6 - column 3, line 32 * * column 4, line 33 - column 5, line 36 * ----	4-7, 17-20	
X	US 4 148 092 A (MARTIN RICKY) 3 April 1979 (1979-04-03) * abstract * * column 2, line 12 - line 61 * * column 3, line 58 - column 5, line 56 * * column 12, line 10 - line 43; figures * ----	1,12-14, 25,26	
Y	US 4 745 784 A (GARTNER KLAUS) 24 May 1988 (1988-05-24) * abstract * * column 5, line 9 - line 16 * -----	4-7, 17-20	
			TECHNICAL FIELDS SEARCHED (Int.Cl.7)
			E05B
The present search report has been drawn up for all claims			
Place of search THE HAGUE		Date of completion of the search 9 November 2001	Examiner Teutloff, H
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**ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.**

EP 00 12 0978

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
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09-11-2001

Patent document cited in search report		Publication date	Patent family member(s)	Publication date
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For more details about this annex : see Official Journal of the European Patent Office, No. 12/82