United States Patent

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[54] KEY IDENTIFICATION SYSTEM HAVING KEY CODE CONTROL

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[52] **U.S. Cl.** **340/149,** 340/171, 70/277, 317/134, 340/147

[51] **Int. Cl.** **H04q 3/00**

[58] **Field of Search** .....340/149 A, 171, 147; 70/277; 317/134

[56] **References Cited**

UNITED STATES PATENTS

3,500,326	3/1970	Benford	340/147
2,008,150	7/1935	Nelson	70/277
2,057,301	10/1936	Golokow	70/277 X
3,142,166	7/1964	Adam	317/134 X
3,237,183	2/1966	Eagan	317/134 X
3,347,072	10/1967	Rose	317/134 X
3,392,559	7/1968	Hedin	70/277
3,415,087	12/1968	Kramasz	70/277
3,408,838	11/1968	Katz	70/277
2,541,461	2/1951	Churchill	340/149 X
2,967,916	1/1961	Williams	340/149 A
3,154,761	10/1964	O'Gorman	340/149 A
3,394,246	7/1968	Goldman	340/149 A

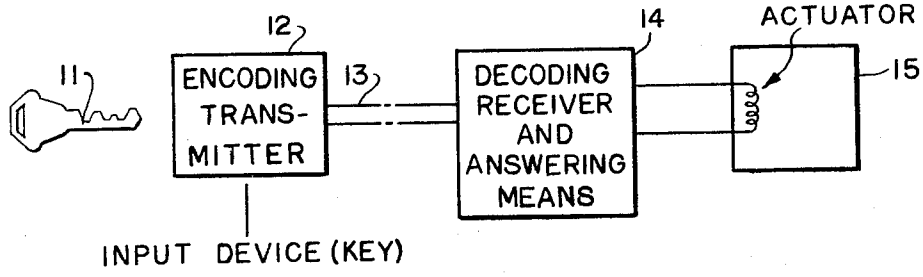
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[57] **ABSTRACT**

A type of ordinary key is inserted into an ordinary looking lock that provides a group of unique tone pairs characteristic of the code identified by the key. These groups of tone pairs are transmitted to a central processing unit. The central processing unit responds to the pairs of frequencies by transmitting appropriate control signals that unlock or refuse to unlock an appropriate lock or indicate that the key holder may or may not be entitled to credit.

9 Claims, 8 Drawing Figures



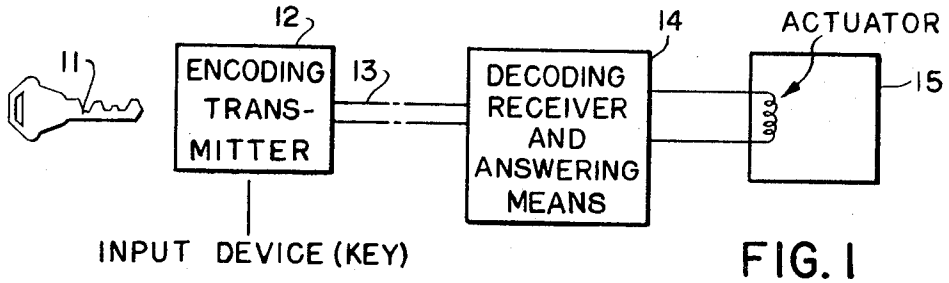


FIG. 1

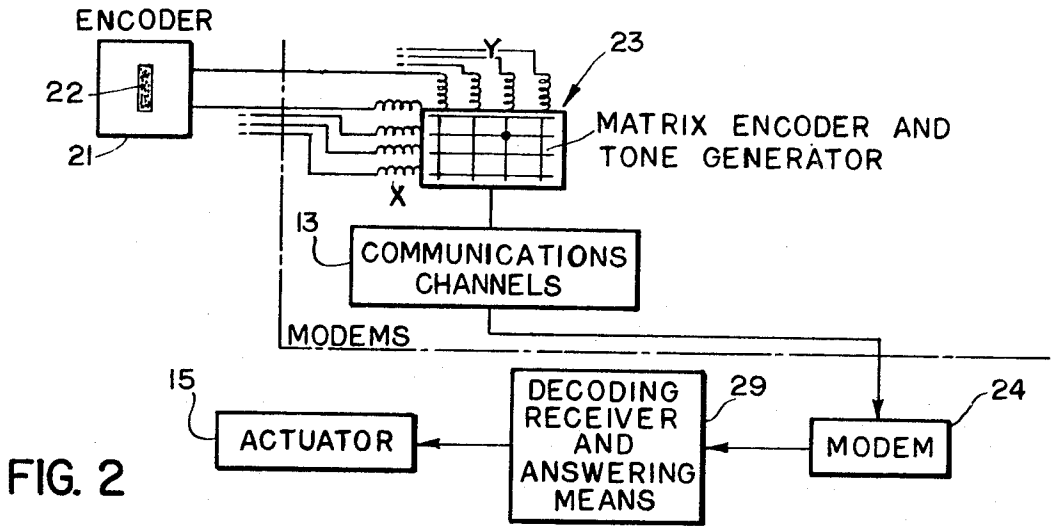


FIG. 2

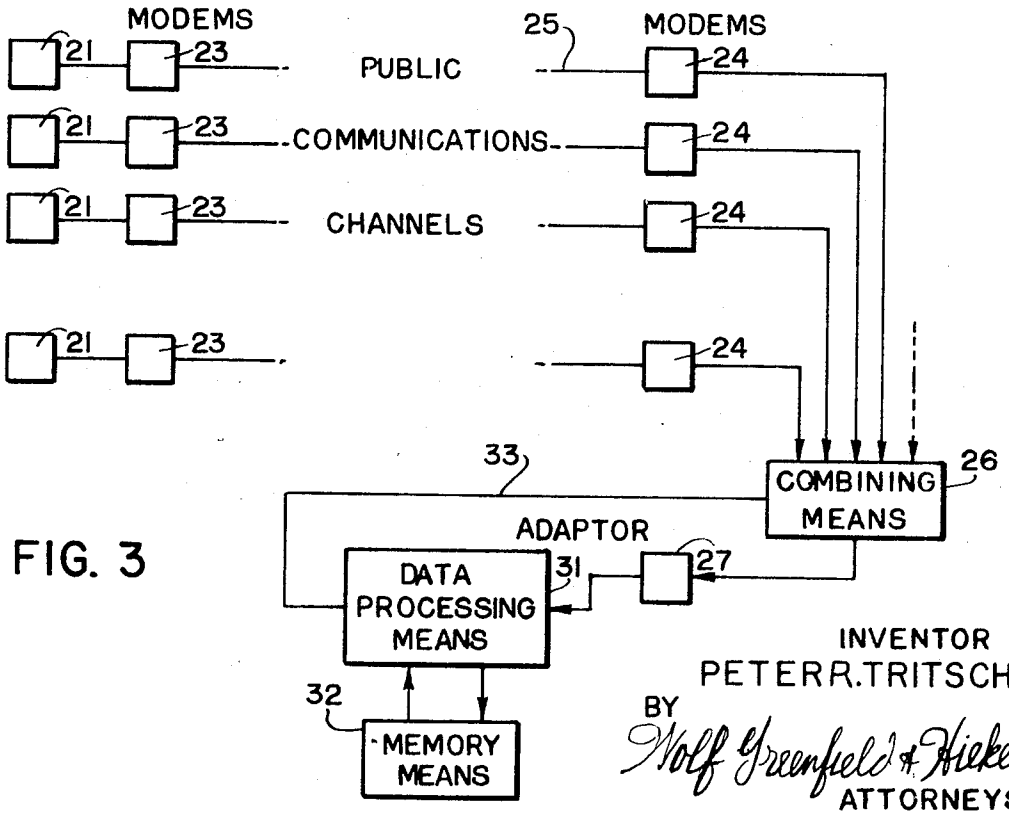


FIG. 3

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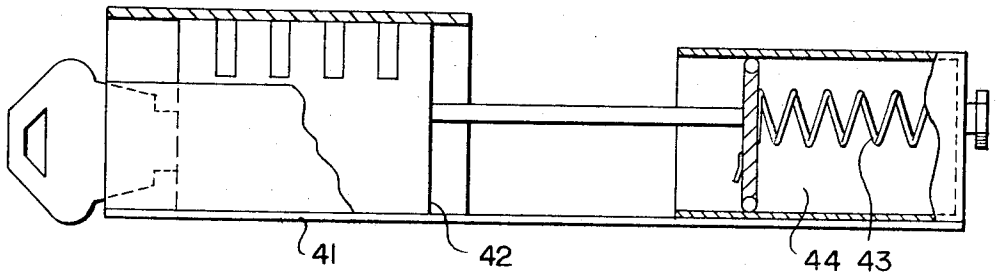


FIG. 4

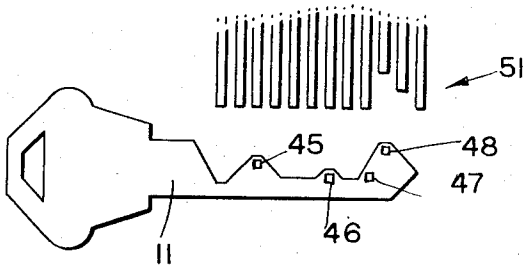


FIG. 5

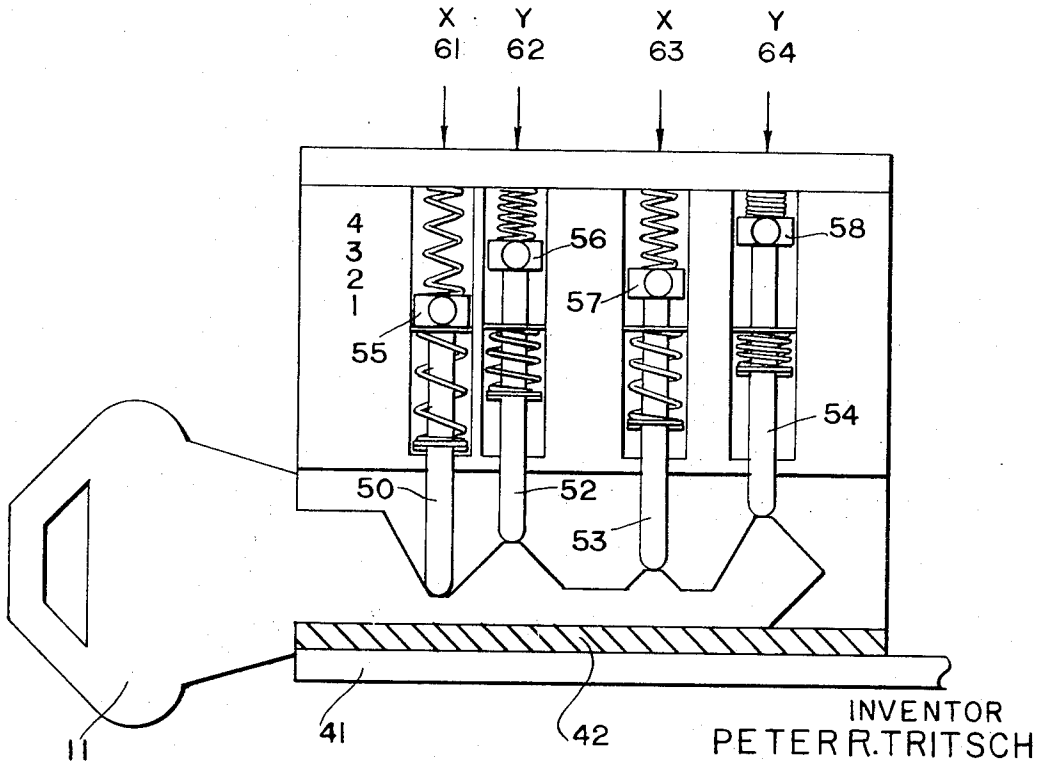


FIG. 6

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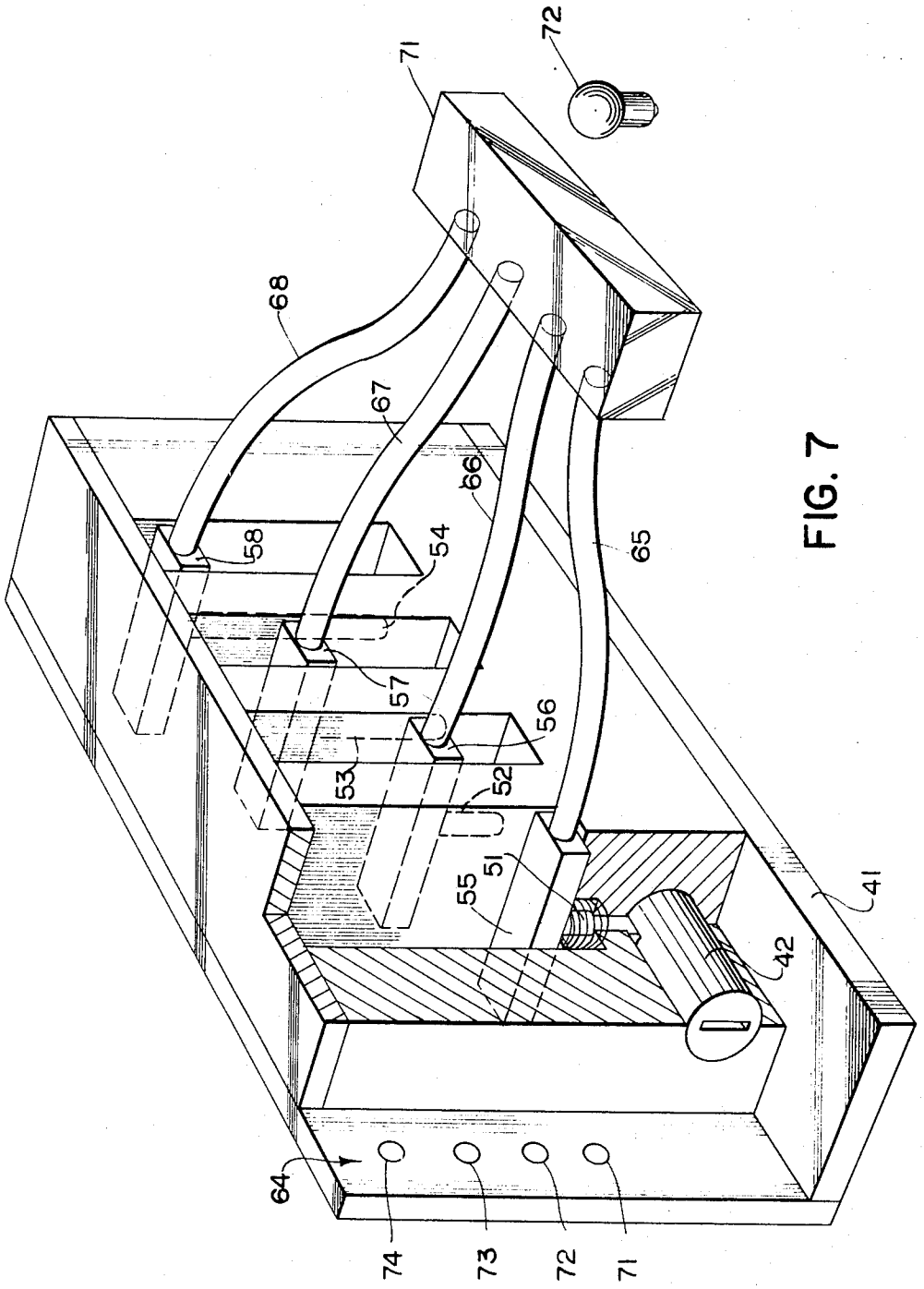


FIG. 7

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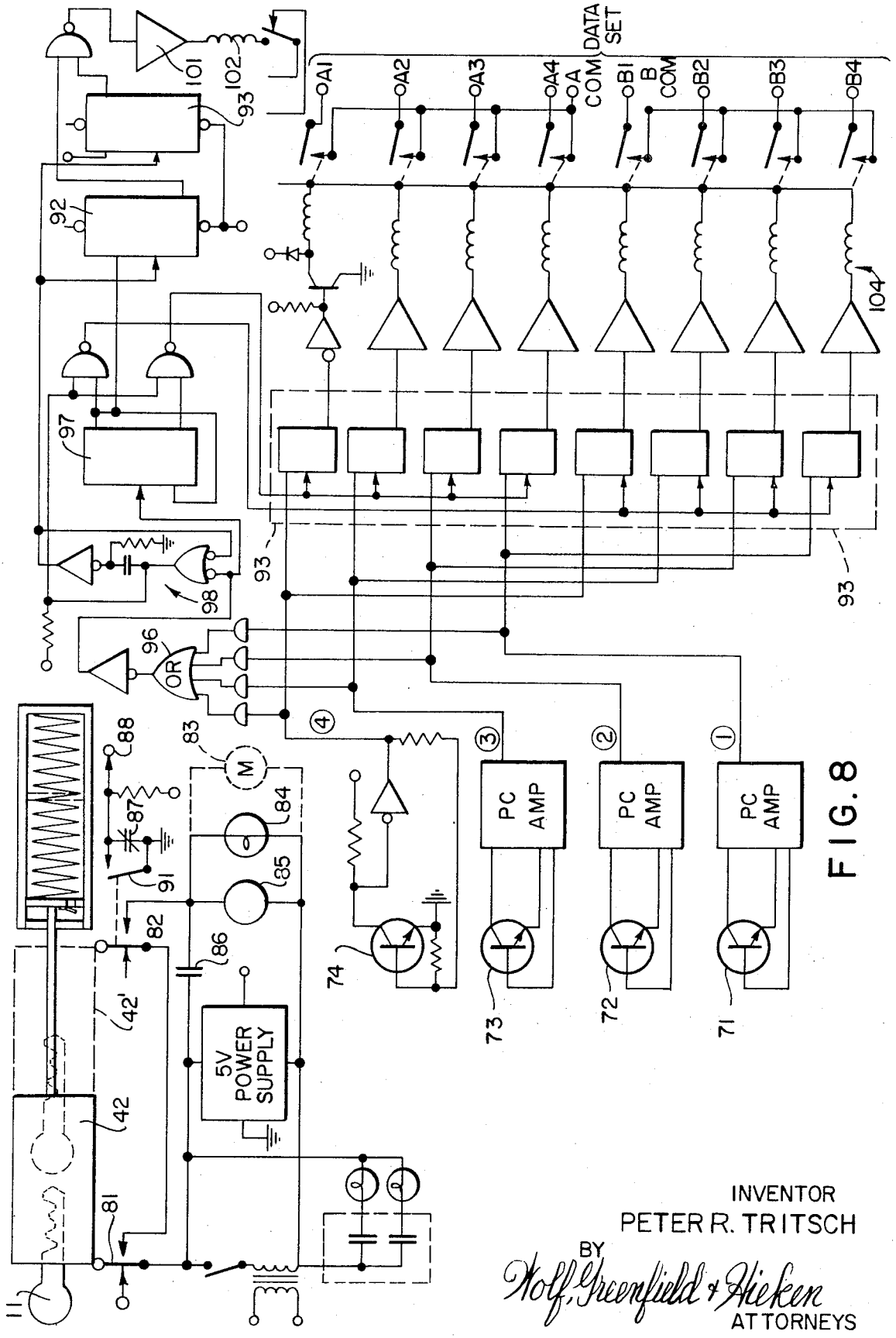


FIG. 8

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KEY IDENTIFICATION SYSTEM HAVING KEY CODE CONTROL

BACKGROUND OF THE INVENTION

The present invention relates in general to secure key control and more particularly concerns a novel system that accepts insertion of an ordinary looking key, decodes that key and produces an appropriate response to the decoding, such as unlocking or refusing to unlock a door or ignition system, or indicating that the key holder should or should not be entitled to credit.

With the widespread use of credit cards the problem of stolen or misused credit cards becomes more serious. Furthermore, the problem of unauthorized persons having access to locked rooms or systems through picking or otherwise bypassing locks becomes more serious. Still another problem associated with ordinary locking systems is that once there is danger of an authorized person having a key to a secured area, for example, if someone loses a key or an employee having a key no longer becomes associated with the firm, mechanical locks must be changed. This changing is both costly and time consuming. And the authorized personnel must each receive a new key each time a lock is changed.

Accordingly, it is an important object of this invention to provide a secure key system.

It is a further object of the invention to achieve the preceding object with an ordinary looking key that causes unlocking only when a central control unit determines that the key seeking the unlocking bears a proper code, a code which may be readily changed.

It is a further object of the invention to achieve one or more of the preceding objects with an ordinary looking key that identifies the key holder as entitled to credit.

It is a further object of the invention to achieve one or more of the preceding objects with apparatus that is relatively inexpensive when considered as a whole and reliable in operation.

SUMMARY OF THE INVENTION

According to the invention, encoding means, such as an ordinary looking key, is inserted into transmitting means that provides a signal, such as audio tone pairs, representative of the code carried by the encoding means. Receiving means accepts the encoding means and provides appropriate identification or nonidentification signals. If the encoded signal is acceptable, the transmitted signal may cause a mechanism to unlock, such as unlocking a door or enabling an ignition system of an automobile. Alternately, it may transmit a signal back to the transmitting means signifying that the key identifies an individual with acceptable credit. If the receiving means identifies the encoding signal as unacceptable, it will refuse to unlock a lock or identify the key as associated with one who has no or limited credit. Alternately, the receiving means could transmit a signal that sounds an alarm or identifies the key as being stolen.

Numerous other features, objects and advantages of the invention will become apparent from the following specification when read in connection with the accompanying drawing in which:

BRIEF DESCRIPTION OF THE DRAWING

FIG. 1 is block diagram illustrating the logical arrangement of a system according to the invention;

FIG. 2 is a block diagram illustrating the logical arrangement of a specific embodiment of the invention in which the encoder is a standard keylike slot and transmits a dual audio tone over telephone lines;

FIG. 3 is a block diagram illustrating the logical arrangement of a credit card checking scheme;

FIG. 4 is a pictorial representation of an exemplary embodiment of the encoding means for mechanically scanning the code carried by an ordinary key;

FIG. 5 illustrates an embodiment in which magnets in the key carry the code and actuate magnetic reed switches;

FIG. 6 is a pictorial representation of the inside of the encoder of FIG. 5 showing a fiberoptic technique for determining the key code;

FIG. 7 is a diagrammatic representation of additional aspects of the encoding system utilizing fiber optics; and

FIG. 8 is a combined block-schematic circuit-pictorial diagram of an encoding system according to the invention for providing encoded data in the form of tone signals.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

With reference now to the drawing and more particularly FIG. 1 thereof, there is shown a block diagram illustrating the logical arrangement of a system according to the invention. A type of ordinary key **11** is inserted into an encoding transmitter **12** that provides a signal on transmission means **13** representative of the code carried by key **11**. This code is decoded by decoding receiver and answering means **14** to provide a response that either does or does not operate actuator **15**, depending upon the relationship of the signal decoded to predetermined conditions. For example, if decoder receiver and answering means **14** is set to recognize a particular code and cause the unlocking of a door, sensing that particular code causes actuator **15** to unlock the door. Decoding receiver and answering means **14** may respond to a number of predetermined codes to effect actuation, and these codes may be selectively changed at any time.

A feature of the invention is that it may decode remotely, accept all keys, the decoding combination may be rapidly changed and accept virtually any number of codes and is especially convenient for use with electronic or computer control. In contrast, a conventional key is decoded by the lock at the point of insertion, normally accepts only a preselected group of keys, has but a single combination or limited set of combinations that is difficult to change and normally relies on mechanical implementation to effect unlocking.

Referring to FIG. 2, there is shown a block diagram illustrating the logical arrangement of a system for encoding the code carried by the key in a form that is especially useful for use with ordinary telephone lines. The encoder **21** includes a slot **22** that accepts any key code of a selected key type. Typically encoder **21** provides tone pairs, an X tone and a Y tone. Preferably there are four X tones and four Y tones with a pair comprising one X tone and one Y tone so that the tone pair identifies one of 16 possible code bits and is compatible with the touch tone telephone system. This 4×4 matrix encoding is represented by the matrix encoder **23** that provides the selection of tone pairs over communication means **13** to modem **24** and then decoding receiver and answering means **14** that appropriately controls actuator **15**. Typically inserting the key in slot **22** closes appropriate relays in matrix encoder and tone generator **23** that select the appropriate tone pairs for transmission.

Referring to FIG. 3, there is shown a block diagram illustrating the logical arrangement of a suitable credit card checking system according to the invention. There may be an encoder **21** at each location where credit is desired to be checked feeding an associated modem **23** that is connected to a corresponding modem **24** at the central location over ordinary telephone lines or other public communications channels **25**. A combining means **26**, which may include multiplexing means for sampling the outputs of modems **24** and coupling them in sequence to an adapter **27** may function to present the data on the different lines to data processing means **31**, preferably in digital form. The data processing means **31** may typically be a general purpose computer or a decode-encode generator of the type used in cryptology. The data processing means **31** may then compare the data with appropriate information in memory means **32** and provide a signal on output line **33** that may distributed by combining means **26** back to the then sensed one of modems **24** for transmission back over the public communication channels **25** to an associated one of

modems 23 and provide an indication of the credit status of the individual associated with the inserted key. For example, the interrogating local station might include three lights, one of which is actuated. Illumination of a green light indicates a specifically good credit check; amber, not more than a predetermined amount; and red that credit should not be extended and probably that appropriate authorities should be immediately alerted. The central location may also include similar indicating means.

The data processing means 31 and memory means 32 may comprise a general digital processing system having both a drum and core memory. The core memory may function as executive or director, carrying sets of criteria for key recognition and associated action. A high-speed tape reader and punch may be utilized for entering and receiving information for permanent inventory. The system could be used to check credit in that the bad credit risks might be stored on the drum, and the key code would be compared to these bad risks. Specific central systems are known in the art and are not described here to avoid obscuring the principles of this invention.

An especially suitable transmission medium is the telephone system adapted to carry the touch-tone frequencies used by the telephone company. There are eight frequencies available arranged in a 4×4 matrix to facilitate encoding one out of 16 discrete values as a combination of two frequencies. To avoid tolerance problems in determining pin heights of a lock cylinder having pins displaced in accordance with the configuration of peaks and valleys in a conventional key, it has been found to be advantageous to decode the pin height into four levels whereby contiguous pairs of pins would select the frequency pairs so that two successive pin heights could be transmitted as a two frequency signal in accordance with already acceptable telephone company standards.

Although more pin pairs and more discernible pin height would provide many possible combinations, a special key that looks different from the average key may be required. The different appearance of such a key might compromise the security of the system, a feature of the invention being that the coded key looks like any other key. This possible problem posed by this implementation may be overcome by using two common keys with six pins each, thereby providing 2^{24} combinations if the keys are inserted in proper sequence.

Referring to FIG. 4, there is shown a means for scanning the code carried by the key 11. A stationary cylinder guide 41 carries a moving cylinder 42 that is urged rearward against spring 43 inside dash pot 44 when key 11 is inserted. Spring 43 then urges moving cylinder 42 back along key 11 to scan its projections and depressions in sequence. FIG. 5 shows an embodiment of the invention in which key 11 carries small imbedded magnets, such as 45, 46, 47 and 48 for actuating respective ones of magnetic reed switches 50 when key 11 is fully inserted. Respective ones of the reed switches 50 may sequentially activate tone oscillators to transmit the desired signal sequence. This approach is especially economical when keys are produced in quantities of 10,000 and over.

Referring to FIG. 6, there is shown a photoelectromechanical arrangement for decoding the key. Key 11 is shown inside moving cylinder block 42. Moving cylinder block 42 is shown with four spring-loaded pins 51, 52, 53 and 54 having respective caps 55, 56, 57 and 58 formed with openings for transmitting light to an associated photoelectric transducer through a respective one of four fiber optical filaments in respective ones of plane 61, 62, 63 and 64. The position of the associated opening allows light to be transmitted to one and only one of four associated photoelectric transducers. Thus, pins 51 and 52 denote the tone pair X_1 and Y_3 while pins 53 and 54 denote the respective tone pairs X_2 and Y_4. Instead of photoelectric transducers in the planes 61, 62, 63 and 64, there could be a set of four magnetic reed switches in each of these planes, and the caps 55, 56, 57 and 58 could be small permanent magnets that would close one, and only one, of the four reed switches in a respective plane to provide the appropriate encoding signals.

Referring to FIG. 7, there is shown a diagrammatic representation of a suitable means for photoelectrically sensing the positions of the four pins. Fiber bundle 65, 66, 67 and 68 carry light distributed by plastic block 71 of lucite or other suitable material from light source 72 to caps 55, 56, 57 and 58, respectively, of pins 51, 52, 53 and 54. The column of photocells in plane 64 are energized in the sequence of pins 51, 52, 53 and 54 as moving cylinder block 42 is returned forward. In the specific configuration shown in FIG. 7, first photocell 71 would be energized, then photocell 72, then photocell 73, then photocell 74. Thus, the specific code carried by the key producing the pin displacement of FIG. 7 is X_1, Y_2 and X_3, Y_4. Numerous other techniques may be used to encode the key configuration, such as differential transformers, photosensitive devices, resistive elements, sliding contacts and the like.

For example, the key lands could mechanically position a number of lock pins with each lock pin having an opening that is in line with the other openings only when the key with acceptable code is inserted. By locating the pins between a light source and photocell along such line, the photocell is energized to signify acceptance only when all the lock pin openings are in line.

Referring to FIG. 8, there is shown a combined pictorial block-schematic circuit diagram of an exemplary encoding means according to the invention. Inserting key 11 into moving cylinder 42 causes the arm 81 of tip limit switch S1 and 82 of bottom limit switch S2 to move to the right and energize scan motor 83, illuminate scan lamp 84 and operate power relay K1 85 to close normally open contact 86 and keep power on until the scan is completed while opening normally closed contacts 87 to provide a reset signal on line 88 as contacts 91 of bottom limit switch S2 are closed. Flip-flops 92 and 93 are thereby cleared. Scan motor 83 then causes moving cylinder 42 to move to the left from the position 42′ back to position 42 so that the photoelectric transistors scan the four pin positions in sequence.

When a key is inserted, its four key lands raise four corresponding pins to one of the four levels. In a key having eight key lands, eight corresponding pins may be raised to one of four levels so that two of the eight pins will be positioned at the same level. Then the whole assembly is scan-driven past the vertical stack of four optical targets, the phototransistors 71, 72, 73 and 74. The system of FIG. 8 has means for monitoring eight rods serially and storing the monitored signal in the A register 93 and the B register 94, each of these registers capable of storing four bits.

Phototransistors 71, 72, 73 and 74 may typically be Fairchild FPT 100 phototransistors followed by a 7,400N amplifier 95. The latter is an integrated circuit having photocell amplifiers thereon. The outputs of the photocell amplifiers 95 are OR-gated in the strobe gate 96 to trigger a strobe flip-flop 97 and a one-shot circuit 98, which indirectly gates strobes A and B to the A storage register 93 and B storage register 94. In addition, the one-shot output triggers flip-flops 92 and 93 for oscillator turn on control executed by amplifier 101 and relay 102. The outputs 1, 2, 3 and 4 from the photocell amplifiers 95 are connected to the A storage register 93 and B storage register 94 in pairs with lines 1—4 going to the cells designated 1–4 appended to an appropriate A or B. Although one data bit is simultaneously presented to both registers, only one is loaded because strobes and B are mutually exclusive. Thus, four photocell outputs are stored in eight register flip-flops.

The eight data bits control eight relay closures of relays and relay drivers 104. The relay closure grouping conforms to the AT&T data set specifications, with a separate common for group A and B.

There has been described a secure key system characterized by flexibility, security and reliability at relatively low cost when measured against the advantage of the system. It is apparent that those skilled in the art may now make numerous departures from and modifications and variations of the specific embodiments described herein without departing

from the inventive concepts. Consequently, the invention is to be construed as embracing each and every novel feature and novel combination of features present in or possessed by the apparatus and techniques herein disclosed and limited solely by the spirit and scope of the appended claims.

What is claimed is:

1. Apparatus for identifying an ordinary looking key having lands any of which may be within at least three different height ranges comprising,

key accepting means for receiving an ordinary looking key and providing an electrical key signal representative of the identifying code carried by lands of the received key,

said key accepting means including means responsive to the land of the received key for providing a large plurality of electrical key signals each representative of a different code carried by a different arrangement of key lands and having a signal portion for each land sensed indicating which of said at least three height ranges embraces the sensed land,

receiving means responsive to said electrical key signal for providing one of identification and nonidentification signals,

and utilization means responsive to the identification and nonidentification signals for providing a predetermined response.

2. Apparatus in accordance with claim 1 wherein said utilization means comprises actuating means for establishing an unlocked condition only in response to said identification signal.

3. Apparatus in accordance with claim 1 wherein said electrical key signal comprises audio tone pairs with each tone pair associated with a corresponding pair of lands and one of at least three tones designating a first land height range and one of at least three tones designating a second land height range in each tone pair.

4. Apparatus in accordance with claim 1 and further comprising means responsive to magnets in said lands in the ordinary looking key for providing said electrical key signal.

5. Apparatus in accordance with claim 1 and further comprising said ordinary looking key in said key accepting means.

6. Apparatus in accordance with claim 4 and further comprising said ordinary looking key in said key accepting means.

7. Apparatus in accordance with claim 1 wherein said receiving means is remote from said key accepting means and said utilization means and further comprising,

means for transmitting said electrical key signal to said receiving means,

and means for transmitting at least one of said identification and nonidentification signals to said utilization means.

8. Apparatus in accordance with claim 6 wherein said receiving means is remote from said key accepting means and said utilization means and further comprising,

means for transmitting said electrical key signal to said receiving means,

and means for transmitting at least one of said identification and nonidentification signals to said utilization means.

9. Apparatus in accordance with claim 7 wherein said electrical key, identification and nonidentification signals comprise audio tone pairs for transmission by said means for transmitting with each electrical key signal tone pair associated with a corresponding pair of lands and one of at least three tones designating a first land height range and one of at least three tones designating a second land height range in each electrical key signal tone pair.

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