

Description

This invention relates to a security apparatus according to the preamble of the main claim.

Such security apparatus is in particular used for access control systems for controlling access to, for example, safes, strong rooms, buildings, security areas in buildings, computer terminals and electronically stored information such as credit records, just to mention a few of the applications where security is required.

The security apparatus of the above mentioned kind is known from the JP—A—54 102 845. This security apparatus comprises a distributing circuit for storing selected digits as the key values in data registers corresponding to the array of the key. Each key is connected with a respective data register via signal lines capable of transmitting data of four bits in parallel and each key further comprises four contacts transmitting the signal from the data registers to the register means or output. For the correct operation it is therefore necessary that the four contacts are properly closed each time a key is pressed. Furthermore, since the actual selected signals pass through the keyboard, it is possible to influence these signals from outside. Also external signals can be fed into the keyboard to set digit values for keys bypassing the keyboard to gain access.

It is the object of the present invention to provide a security apparatus being safer against misuse and more reliable in its operation.

This object is achieved by a security apparatus of the above mentioned kind which is characterized by the features of the characterizing part of claim 1.

In operation of the apparatus the random scrambling of the designated key values prevents an observer from detecting a correct code merely by noting the order in which particular keys are actuated since the position of the keys for the correct code will be changed.

In a simple access control system, access may be obtained solely by operation of the keyboard. In more sophisticated systems, however, additional security equipment may be included. For example, the system may also include a magnetic code reader which must receive a correctly coded instrument such as a key or card to enable the keyboard.

Brief description of drawings

In order that the invention may be more fully explained one particular embodiment will be described in some detail with reference to the accompanying drawings in which:—

Figure 1 is a plan view of a push-button keyboard apparatus constructed in accordance with the invention;

Figure 2 is a side elevation of the apparatus shown in Figure 1;

Figures 3 and 4 illustrate the electrical circuitry of the keyboard apparatus;

Figures 5 and 6 illustrate the manner in which the various electrical components of the

apparatus may be mounted on a pair of circuit boards; and

Fig. 7 is a flow chart detailing the operation of the apparatus.

Best modes of carrying out the invention

With particular reference to Figures 1 and 2 the illustrated keyboard apparatus comprises an outer casing 11 fitted with a keyboard face plate 12. The electrical components of the keyboard are mounted on a pair of parallel printed circuit boards 13, 14 carried on posts 15 fixed to face plate 12 so as to extend within casing 11.

The circuit board 13 carries a series of ten unmarked push button switches S_0 to S_9 arranged in two rows having five switches each. The push buttons of these switches project through apertures in face plate 12 and are unmarked. Board 13 also carries two additional push-button switches marked respectively "C" and "S" (for "Clear" and "Start") and located beneath the two rows of unmarked push button switches S_0 to S_9 .

Board 13 also carries a series of ten single digit numeric display units D_0 to D_9 disposed one above each of the push-button switches S_0 to S_9 and each housed within a tube 22 opening through an aperture in face plate 12. In operation of the keyboard, designations ascribed to the ten key switches S_0 to S_9 are displayed by the corresponding display units D_0 to D_9 and a person operating the keyboard must look straight down the tubes 22 to read the characters displayed.

Before turning to the electrical circuitry of the keyboard, its general mode of operation will be described. A person who wishes to operate the keyboard firstly presses the start button "S". This causes the electrical circuitry of the keyboard to generate a random sequence of 10 digits of values from 0 to 9 and to display these on display units D_0 to D_9 in that random sequence.

The operator then actuates four of the key switches S_0 to S_9 in sequence and the keyboard circuitry operates to assemble a four digit number comprising the four digits displayed for the selected keys. The random sequence of digits is then cleared from the displays and the assembled number is displayed briefly using four of the digit displays only. After this brief confirmation display the four digit displays are extinguished and the assembled number is compared with a valid code number initially set within the system. If the number assembled by operation of the keyboard corresponds with the correct code number a relay is actuated. The relay can be made to operate any sort of external circuit to provide the access required. It may, for example, be connected into the circuit of an electrically operable door. At any time up to the end of the brief confirmation display the clear button "C" may be pressed if a mistake is made.

The keyboard makes use of a microprocessor based circuit providing the logic necessary to scan the key switches, multiplex the numeric displays, generate new random display sequences, and compare the number generated

by the keyboard with a preset valid code number. The functions more precisely are as follows:—

1. Random sequence generation

The microprocessor generates random sequences for display by a combination of a pure random number and a pseudo-random number generator routine within the programme of the microprocessor. The sequence thus generated is stored within the working memory ready for the display multiplexing routines.

2. Display multiplex

When the keyboard is activated by actuation of the "S" key, the microprocessor displays digits in each of the numeric displays in the keyboard. The digit displayed in any position is determined by a random pattern stored in the working memory of the microprocessor.

3. Key switch scan

The microprocessor now "looks" continuously at the key switches waiting for a key depression. When a key is depressed the digit currently displayed in the associated display is stored in the working memory of the microprocessor.

Figure 3 shows the electrical circuit for the components mounted on board 14 and Figure 4 shows the circuit for the components mounted on board 13. Figures 5 and 6 show the physical layout of the various components on the two boards. The circuits of the two boards are interconnected at J3 by a flat cable assembly.

The microprocessor may be a standard 8-bit type 6505 microprocessor and in Figures 3 and 5 it is designated as 23. This microprocessor performs a programme set in a 2516 EPROM designated as 24 and a 128×8 RAM designated as 25 provides the working memory for the microprocessor. A type 6821 parallel interface designated as 26 serves as a programmable input/output port and the functions of its input/output lines are set by the microprocessor.

A series of four binary coded decimal thumb-wheel switches TWS1 to TWS4 are bussed into the input lines of buffer 26 for the purpose of initially setting a valid four digit code number.

Circuit board 14 also carries the relay RLA1 to provide the external access signal, a type 74LS36S three-state buffer designated as 27 and two AND gates 28, 29 (in the one unit) which serve to decode inputs from the microprocessor to buffer 27 and EPROM 24 respectively.

Figure 4 illustrates a standard circuit for multiplexing ten displays having seven segments each. A type 7447 BCD to 7 segment decoder designated as 31 selects the segments while a type 74LS42 BCD to 10 line decoder designated as 32 selects the digit for display. The keyboard switches S_0 to S_9 use the same multiplexing action caused by component 32 successively switching transistors Q_0 to Q_9 . If any one of key switches S_0 to S_9 is actuated, the line KEYSTRB+ (keystrobe+) is taken high at a time when the corresponding one of transistors Q_0 to Q_9 is

switched on. If at this time the three-state buffer 27 is switched on by AND gate 28 the data line D7 will be seen by the microprocessor as being high and can act on that information accordingly.

The operational sequence of the circuit is illustrated by the flow sheet in Figure 7. After power is switched on the microprocessor executes a preliminary clearing and checking routine and then starts operation of a high speed counter which continues to run at about 0.5 megahertz until the start key "S" is depressed.

When the start key "S" is depressed the counter is stopped and the number then in the counter is used to seed the random number generator routine incorporated in the microprocessor programme in EPROM 24. The random number generator generates a first random digit which is transferred to a digit store within the working member 25. Successive digits are taken from the random number generator and, after rejection of any duplicated digits, these are stored at successive locations in the digit store to build up a random sequence of the ten digits 0 to 9.

When the random sequence of ten digits has been stored in memory 25, the microprocessor operates to display these in displays D_0 to D_9 through the multiplexing circuitry of Figure 4. As previously explained the multiplexing circuitry acts successively to switch transistors Q_0 to Q_9 at the time that digits appear in the corresponding displays D_0 to D_9 .

The microprocessor then watches for any actuation of one of the keyboard switches S_0 to S_9 or the clear switch "C". Actuation of one of the key switches is detected by a change in the condition of line KEYSTRB+ and the microprocessor determines the number being displayed from the digit store in the appropriate numeric display at that time. That digit is loaded into a number store also incorporated in the memory 25. This sequence of operation continues until four key switches have been actuated to assemble a four digit number in the number store. If at any time during this sequence of operations the clear button "C" is pressed the microprocessor operates to clear the number stored to enable operation of the keyboard to restart without changing the random sequence of digits displayed.

When a four digit number has been assembled in the number store, the microprocessor operates to blank the displays D_0 to D_9 and then display the stored number using four of those displays. The number is thus displayed for three seconds. If the clear button "C" is actuated during this short time interval, the microprocessor restarts the whole sequence of operation.

Provided that button "C" is not pressed within the three second time interval, the microprocessor operates to blank out the display and then to interrogate the thumbwheel switches TWS1 to TWS4 to determine the code number set on these switches. The outputs of each bit of the switches are isolated from one another by diodes and the common terminals of the switches are

connected to the output lines OD0 to OD3. The output lines are normally held low by the programme running in the microprocessor except when it is required to interrogate the values set up on the switches. At this time the programme causes the lines OD0 to OD3 to go high in succession while at the same time reading the value from the particular switch whose common has been caused to go high. For example, if OD0 goes high the binary value of the digit set up on TWS1 is caused to be applied to ID0 to ID3 and this value is stored in memory 25. OD0 then goes low and OD1 goes high and so on until all four switches have been interrogated. In this way the code number set up on the thumbwheel switches is assembled in the memory 25. If this number is the same as the number generated by the keyboard and assembled in the number store, relay RLA1 is actuated and after ten seconds is switched off whereupon the microprocessor reverts to the start of its operating sequence. If the number generated by the keyboard is not the same as the number set by the thumbwheel switches the microprocessor reverts directly to the start of its operating routine and the relay is not actuated.

The illustrated apparatus has been advanced by way of example only and it could be modified considerably. For example, although this apparatus incorporates thumbwheel switches for setting up a valid four digit code it would be quite possible to load valid codes directly into the EPROM 24. In fact this alternative would provide much more flexibility in more sophisticated systems. For example, the programme could require separate entry of successive sequences of numbers generated by the keyboard and it would also be possible to use an alphanumeric system.

The keyboard could be used in association with a device for reading a magnetically coded key or card, in which case the valid code number for comparison with the keyboard number may be determined by the magnetic coding of the key or card and may change according to the particular key or card used. The number comparison could be carried out in a control processing unit disposed at a location remote from the keyboard in which case the keyboard would merely provide an output indicative of the number generated by operation of the keys.

In the illustrated embodiment the key designations are scrambled when a start button is pressed immediately prior to operation of the keyboard, but other arrangements are quite possible. For example, the key designations could be scrambled after actuation of each key or in response to actuation of a predetermined number of keys or on actuation of an "Enter" key after completion of a sequence of key operations.

Although the illustrated embodiment of the invention makes use of a microprocessor and employs software to achieve key designation and scrambling it would also be possible to provide hard-wired circuitry for these purposes.

Industrial applicability

Apparatus according to the invention may be incorporated in any security system for controlling physical access to a security area or for controlling access to data storage equipment and/or information stored in such equipment.

Claims

1. Security apparatus comprising a keyboard (13) having an array of selectively actuatable keys ($S_0 \dots S_9$), key value designation means (24, 25) with a random number generator (23, 24) for generating random digits and a memory storage (25) for storing the random digits in successive locations of a digit storage array corresponding to the array of the keys ($S_0 \dots S_9$), display means comprising an array of display units ($D_0 \dots D_9$) each corresponding to a respective key ($S_0 \dots S_9$) and associated to a respective location of the digit storage array, and register means (23) to register for each key actuation the value designated to the actuated key ($S_0 \dots S_9$), characterized by means for successively addressing the locations of the digit storage array, a multiplexing circuit (31, 32) for, in response to the successive addressing of said digit storage array locations,

—controlling the data transfer of the random digits from those locations to the corresponding associated display units ($D_0 \dots D_9$) and

—scanning the corresponding keys ($S_0 \dots S_9$) of the keyboard, the value of an actuated key being that contained in the corresponding location in the digit storage array; and

means for transferring the value of the actuated key into a number store.

2. Security apparatus according to claim 1, characterized in that the multiplexing circuit provides a key scanning signal for a particular key ($S_0 \dots S_9$) at the same time as a signal for actuating the corresponding display unit ($D_0 \dots D_9$).

3. Security apparatus as claimed in claim 1 or 2, characterized in that the display units ($D_0 \dots D_9$) comprise light emitting diode or liquid crystal displays.

4. Security apparatus as claimed in any of the claims 1 to 3, characterized in that the display units ($D_0 \dots D_9$) are located adjacent the respective keys ($S_0 \dots S_9$).

5. Security apparatus as claimed in any of claims 1 to 4, characterized in that the key value designation means (24, 25) is inoperative until an additional key (S) is actuated.

6. Security apparatus as claimed in any one of the preceding claims, characterized in that there is further provided comparator means to compare a sequence of values entered into the number store upon sequential operation of a number of said keys ($S_0 \dots S_9$) with a sequence of values representing a preselected code and output means conditioned by the outcome of that comparison.

connected to the output lines OD0 to OD3. The output lines are normally held low by the programme running in the microprocessor except when it is required to interrogate the values set up on the switches. At this time the programme causes the lines OD0 to OD3 to go high in succession while at the same time reading the value from the particular switch whose common has been caused to go high. For example, if OD0 goes high the binary value of the digit set up on TWS1 is caused to be applied to ID0 to ID3 and this value is stored in memory 25. OD0 then goes low and OD1 goes high and so on until all four switches have been interrogated. In this way the code number set up on the thumbwheel switches is assembled in the memory 25. If this number is the same as the number generated by the keyboard and assembled in the number store, relay RLA1 is actuated and after ten seconds is switched off whereupon the microprocessor reverts to the start of its operating sequence. If the number generated by the keyboard is not the same as the number set by the thumbwheel switches the microprocessor reverts directly to the start of its operating routine and the relay is not actuated.

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— controlling the data transfer of the random digits from those locations to the corresponding associated display units ($D_0 \dots D_9$) and

— scanning the corresponding keys ($S_0 \dots S_9$) of the keyboard, the value of an actuated key being that contained in the corresponding location in the digit storage array; and

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Revendications

1. Appareil de sécurité comprenant un clavier (13) présentant une disposition de touches ($S_0 \dots S_9$) pouvant être actionnées sélectivement, des moyens de désignation de valeur de touches (24, 25) comportant un générateur de nombre aléatoire (23, 24) pour engendrer des chiffres aléatoires et une mémoire (15) pour mémoriser les chiffres aléatoires à des emplacements successifs d'une disposition de mémorisation de chiffres correspondant à la disposition des touches ($S_0 \dots S_9$), des moyens d'affichage comprenant une disposition d'unités d'affichage ($D_0 \dots D_9$) correspondant chacune à une touche respective ($S_0 \dots S_9$) et associées chacune à un emplacement respectif de la disposition de mémorisation de chiffres, et des moyens d'enregistrement (23) pour enregistrer, pour chaque actionnement de touche, la valeur attribuée à la touche actionnée ($S_0 \dots S_9$), caractérisé par des moyens pour adresser successivement les emplacements de la disposition de mémorisation de chiffres, un circuit de multiplexage (31, 32) pour, en réponse à l'adressage successif des emplacements de la disposition de mémorisation de chiffres:

- commander le transfert de données des chiffres aléatoires de ces emplacements aux unités d'affichage associées correspondantes ($D_0 \dots D_9$) et
- explorer les touches correspondantes ($S_0 \dots S_9$) du clavier, la valeur de chaque touche actionnée étant celle qui est contenue dans l'emplacement correspondant de la disposition de mémorisation de chiffres; et des moyens pour transférer la valeur de la touche actionnée à une mémoire de nombres.

2. Appareil de sécurité selon la revendication 1 caractérisé par le fait que le circuit de multiplexage fournit un signal d'exploration pour une touche particulière ($S_0 \dots S_9$) en même temps qu'un signal d'actionnement de l'unité d'affichage correspondante ($D_0 \dots D_9$).

3. Appareil de sécurité selon l'une des revendications 1 et 2, caractérisé par le fait que les unités d'affichage ($D_0 \dots D_9$) constituent des affichages à diodes à émission de lumière ou à cristaux liquides.

4. Appareil de sécurité selon l'une des revendications 1 à 3, caractérisé en ce que les unités d'affichage ($D_0 \dots D_9$) sont situées auprès des touches respectives ($S_0 \dots S_9$).

5. Appareil de sécurité selon l'une des revendications 1 à 4, caractérisé en ce que les moyens de désignation de valeur de touche (24, 25) sont hors d'action jusqu'à ce qu'une touche supplémentaire (S) soit actionnée.

6. Appareil de sécurité selon l'une quelconque des revendications précédentes, caractérisé par le fait qu'il est en outre prévu des moyens de comparaison pour comparer une succession de valeurs introduites dans la mémoire de nombres

lors de l'actionnement successif d'un certain nombre des touches ($S_0 \dots S_9$) à une succession de valeurs représentant un code choisi à l'avance et des moyens de sortie conditionnés par le résultat de cette comparaison.

Patentansprüche

1. Sicherheitsvorrichtung mit einer Tastatur (13) mit einem Feld von wahlweise betätigbaren Tasten ($S_0 \dots S_9$), einer Tastenwert-Bestimmungsvorrichtung (24, 25) mit einem Zufallszahlengenerator (23, 24) zum Erzeugen von Zufallsziffern und einem Speicher (25) zum Abspeichern der Zufallsziffern an aufeinanderfolgenden Stellen eines dem Feld der Tasten ($S_0 \dots S_9$) entsprechenden Ziffernspeicherfeldes, einer Anzeigevorrichtung mit einem Feld von Anzeigeeinheiten ($D_0 \dots D_9$), von denen jede einer entsprechenden Taste ($S_0 \dots S_9$) entspricht und jeweils einer Stelle des Ziffernspeicherfeldes zugeordnet ist, und einer Registriervorrichtung (23) zum Registrieren des der betätigten Taste ($S_0 \dots S_9$) zugeordneten Wertes bei jeder Tastenbetätigung, gekennzeichnet durch eine Vorrichtung zum aufeinanderfolgenden Adressieren der Stellen des Ziffernspeicherfeldes, eine Multiplex-Schaltung (31, 32) zum

- Steuern des Datentransfers der Zufallsziffern von diesen Stellen zu den entsprechenden zugeordneten Anzeigeeinheiten ($D_0 \dots D_9$) und
- Abfragen der entsprechenden Tasten ($S_0 \dots S_9$) der Tastatur, wobei der Wert einer betätigten Taste derjenige ist, der an der entsprechenden Stelle im Ziffernspeicherfeld enthalten ist,

in Antwort auf das aufeinanderfolgende Adressieren der Stellen des Ziffernspeicherfeldes, und

eine Vorrichtung zum Übertragen des Wertes der betätigten Taste in einen Zahlenspeicher.

2. Sicherheitsvorrichtung nach Anspruch 1, dadurch gekennzeichnet, daß die Multiplex-Schaltung ein Tastenabtastsignal für eine bestimmte Taste ($S_0 \dots S_9$) zur gleichen Zeit wie ein Signal zum Betätigen der entsprechenden Anzeigeeinheit ($D_0 \dots D_9$) liefert.

3. Sicherheitsvorrichtung nach Anspruch 1 oder 2, dadurch gekennzeichnet, daß die Anzeigeeinheiten ($D_0 \dots D_9$) LED's oder LCD's aufweisen.

4. Sicherheitsvorrichtung nach einem der Ansprüche (1—3, dadurch gekennzeichnet, daß die Anzeigeeinheiten ($D_0 \dots D_9$) neben den entsprechenden Tasten ($S_0 \dots S_9$) angeordnet sind.

5. Sicherheitsvorrichtung nach einem der Ansprüche 1 bis 4, dadurch gekennzeichnet, daß die Tastenwert-Bestimmungsvorrichtung (24, 25) außer Betrieb ist, bis eine zusätzliche Taste (S) betätigt ist.

6. Sicherheitsvorrichtung nach einem der vorhergehenden Ansprüche, dadurch gekennzeichnet, daß ferner eine Vergleichsvorrichtung



zum Vergleichen einer nach aufeinanderfolgender
Betätigung einer Anzahl von Tasten ($S_0 \dots S_9$) in
den Zahlenspeicher eingegebenen Zahlenfolge

mit einer einen vorgewählten Code darstellenden
Wertfolge und eine vom Ergebnis des Vergleichs
beeinflusste Ausgabevorrichtung vorgesehen ist.

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