

[54] **ELECTRONIC SECURITY SYSTEMS
FOR MULTI-ROOMED BUILDINGS**

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[22] Filed: **Dec. 1, 1969**

[21] Appl. No.: **881,199**

[52] U.S. Cl. **340/149 R**, 340/164, 340/286

[51] Int. Cl. **E05b 49/00**, G06k 7/06, H04q 3/02

[58] Field of Search.....340/149, 164, 286, 171;
317/134

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[57] **ABSTRACT**

An electronic security system is provided for use in large institutions, such as hotels. A particular room is assigned a data-bearing room access device, (which may physically resemble a key), chosen at random from a group of such devices, the device bearing coded information which is entered and stored in a control unit at a memory location previously assigned to that room number. Until this information is removed from the memory, access to the room cannot be obtained except through the use of a device containing the required information, and further, attempted unauthorized access will cause an alarm signal to be activated.

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14 Claims, 8 Drawing Figures

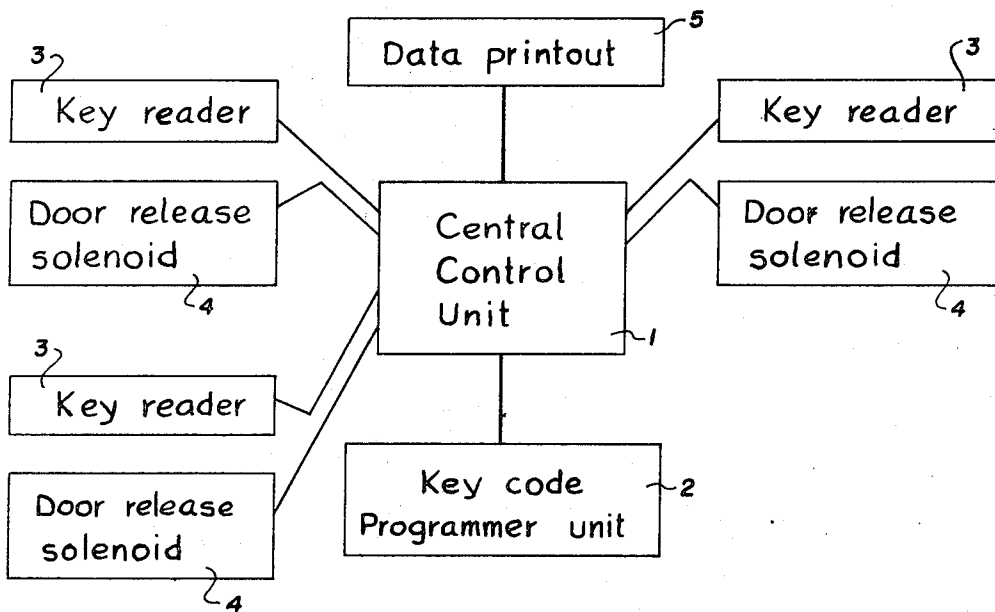


Fig. 1.

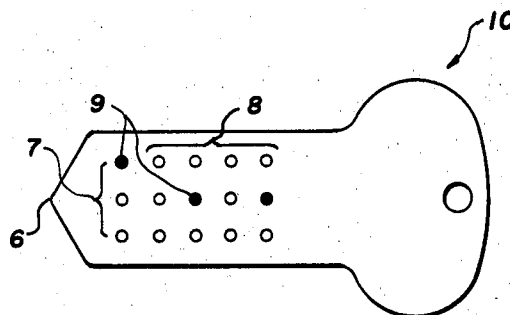
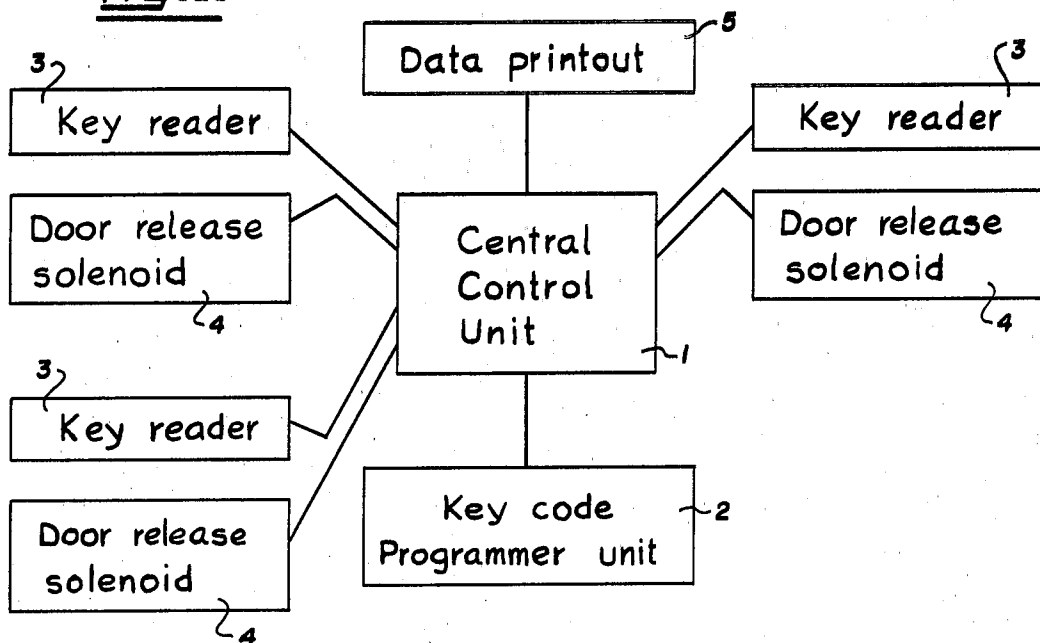


Fig. 2.

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Fig. 3.

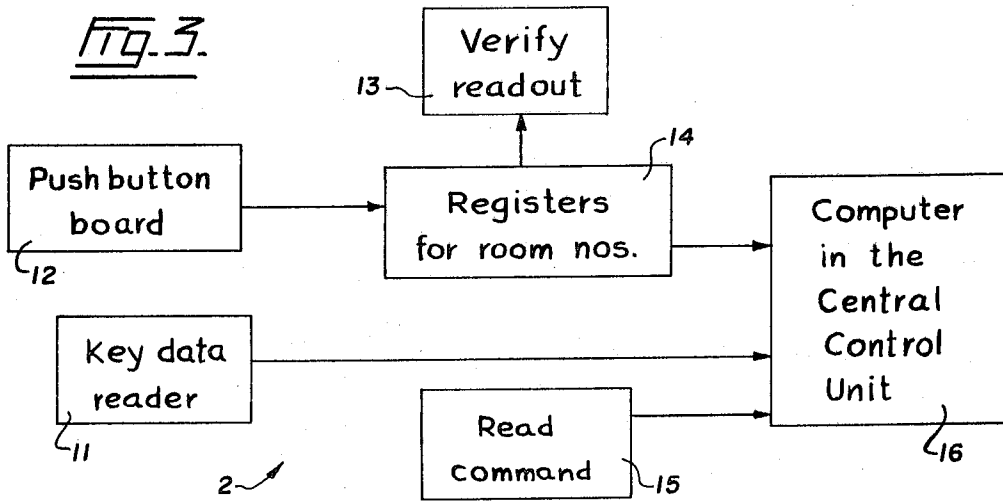


Fig. 4.

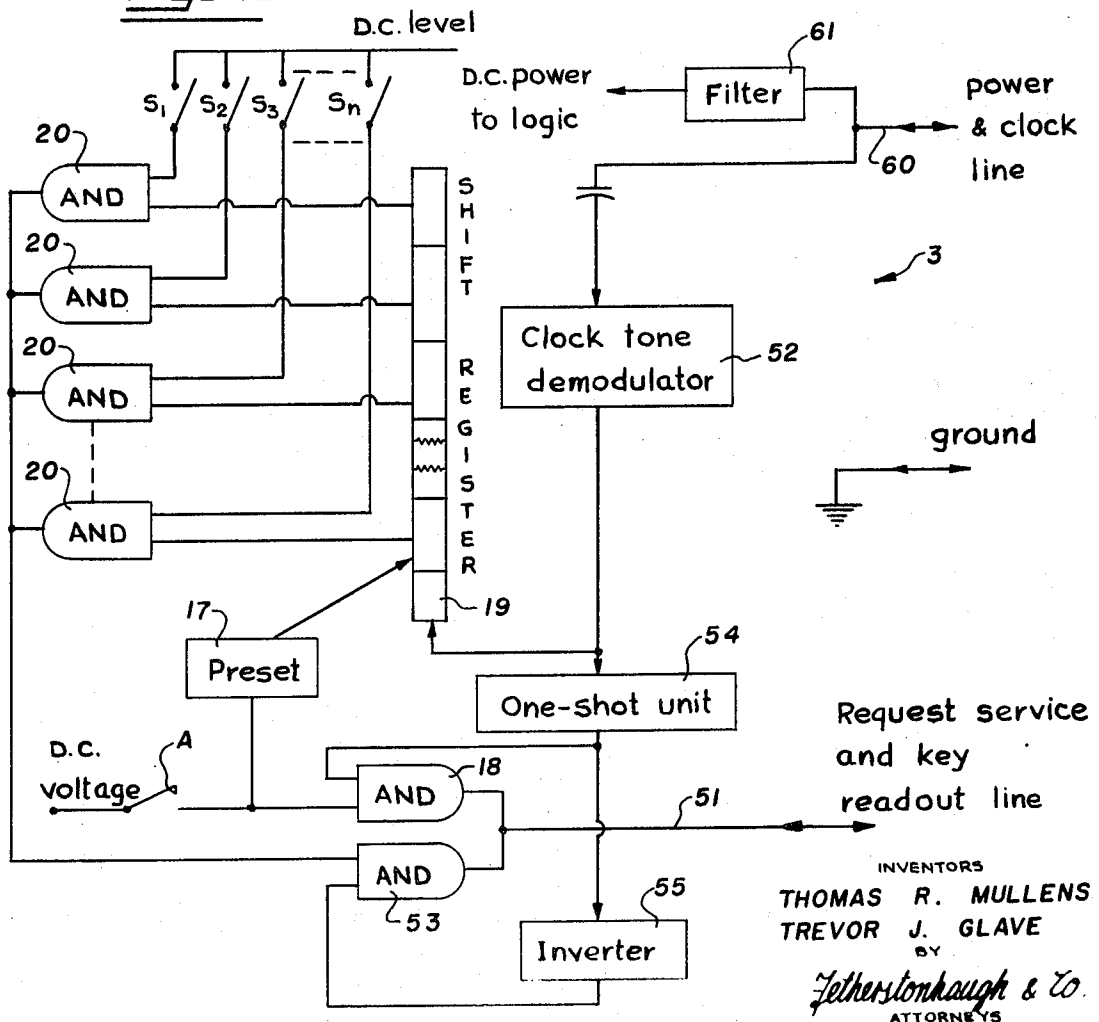
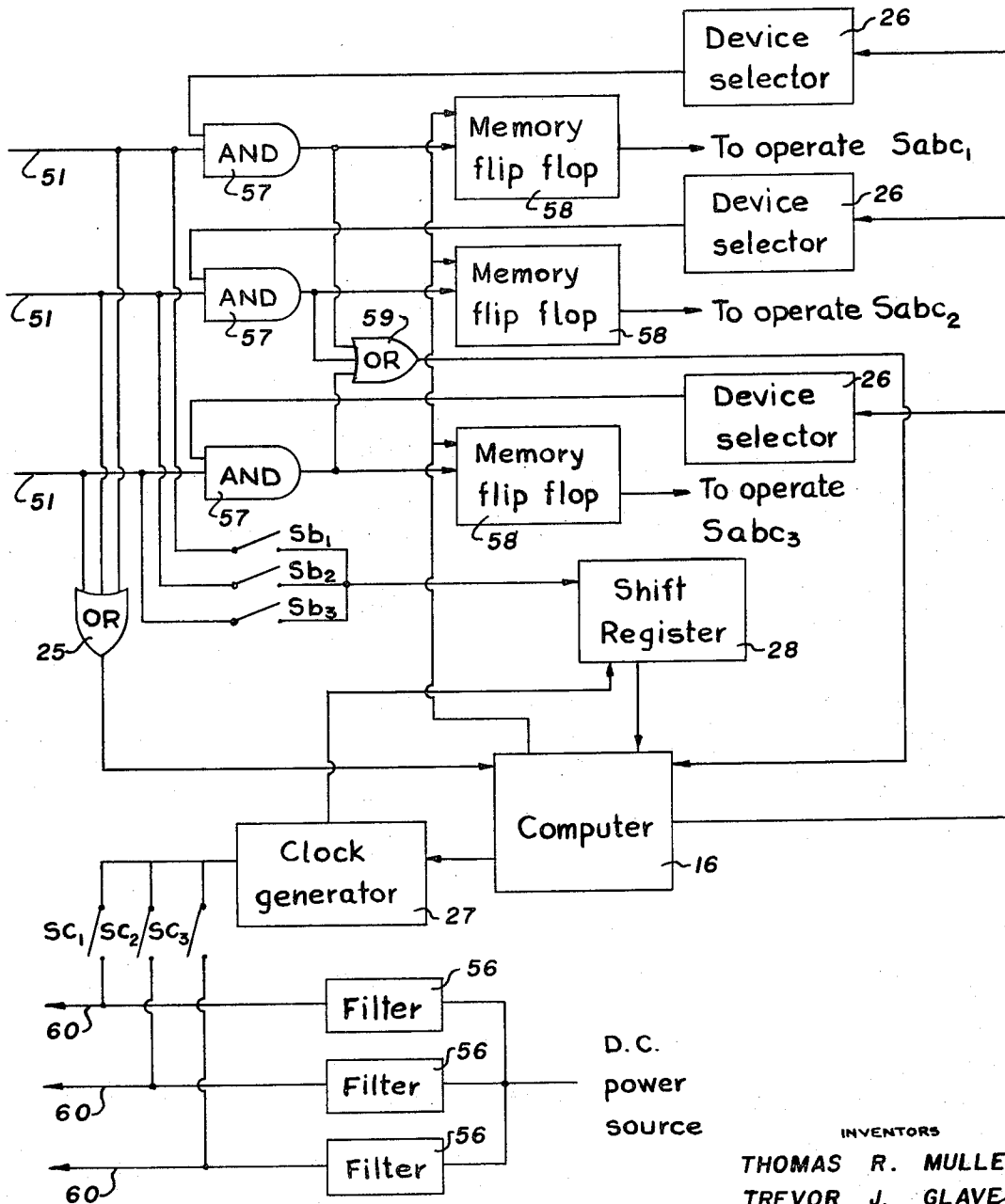
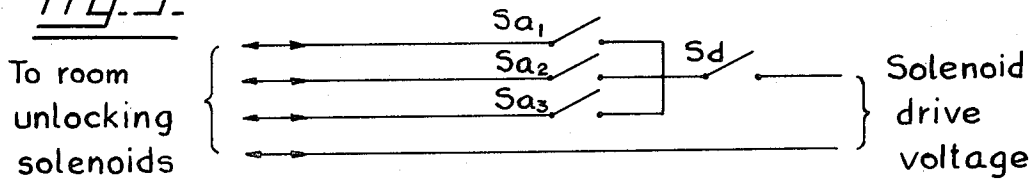


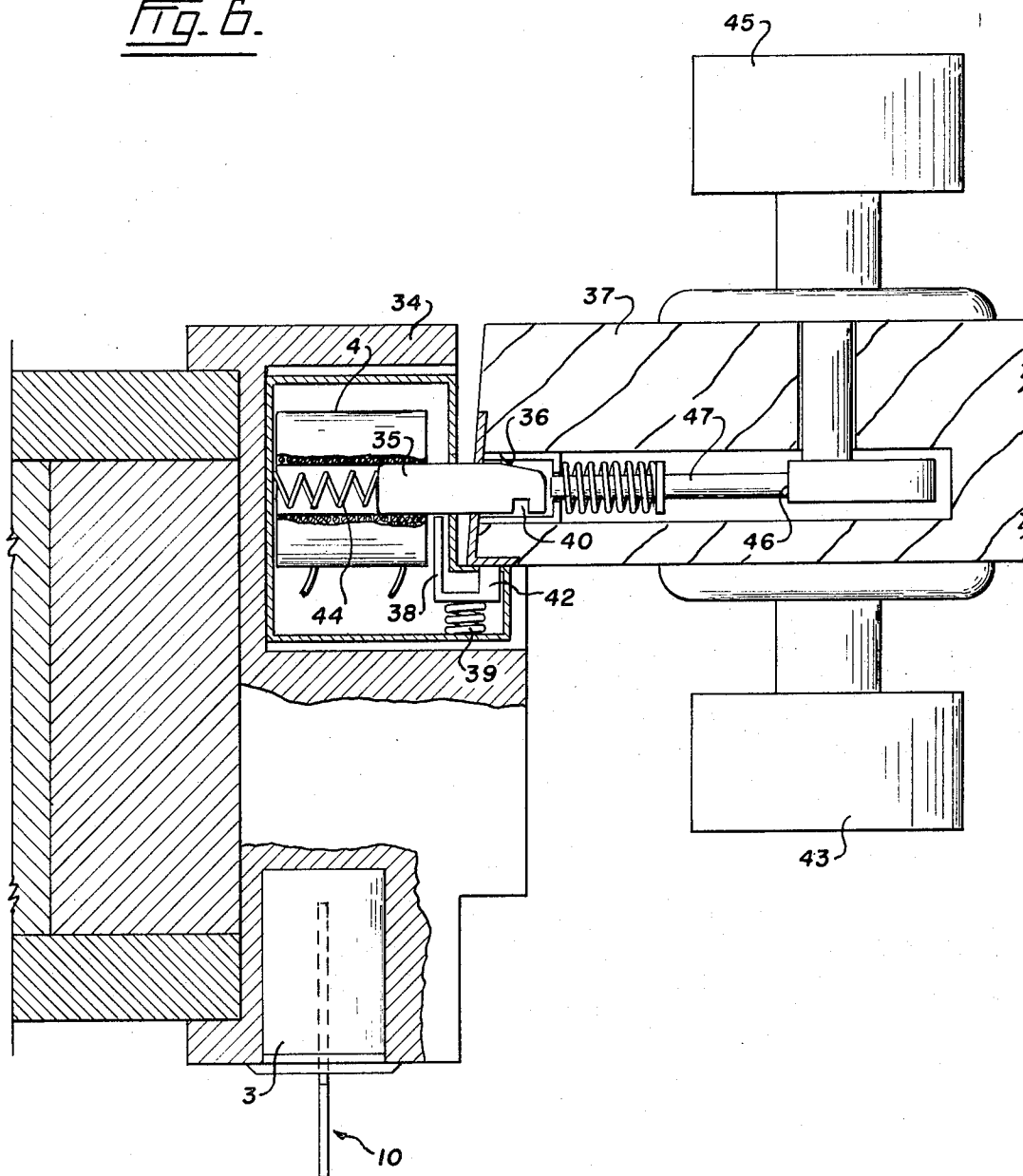
Fig. 5.



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Fig. 6.



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Fig. 7.

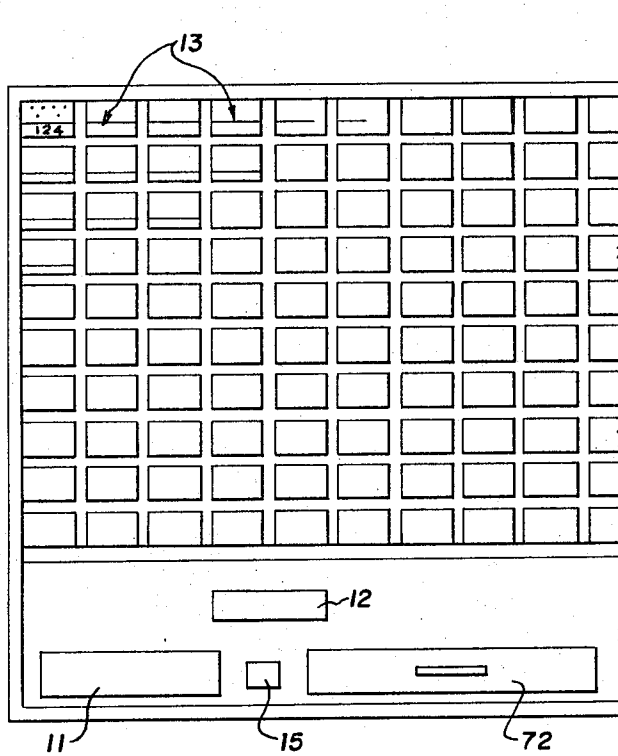
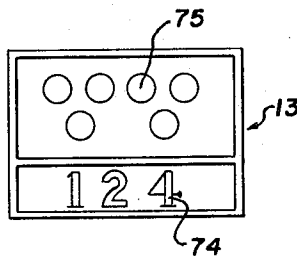


Fig. 8.



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ELECTRONIC SECURITY SYSTEMS FOR MULTI-ROOMED BUILDINGS

BACKGROUND OF THE INVENTION

This invention relates to an electronic security system for use in buildings, such as hotels, having a large number of rooms required to be locked. The security system according to the invention is intended to replace the conventional key and lock system now in general use in such buildings. While the discussion of the invention contained herein is directed to its use in a hotel, it will be understood that the system could be used in any institution requiring a large number of rooms to be locked, or having a number of enclosures, areas, etc., to which unauthorized access is not permitted. In addition, the system could be used in association with other enclosures, such as security lockers or deposit boxes, and the word "room" is intended to include such enclosures.

The lock-and-key system now used employs the pin-tumbler method and has remained substantially unchanged for many years. Due to the general inflexibility of this system, however, it is vulnerable to those persons who desire to gain unauthorized access to rooms. For example, many employees have master keys which will open any of the locks in a particular building, and the connivance of such employees with burglars is one of the hazards confronting hotel management. Moreover, a previous user of a room may have taken a key away with him, or may have had a key made from an authorized key.

In addition, the use of security measures poses the risk of offending registered guests, especially in larger hotels where large transient population renders difficult the recognition of individuals.

These and other problems inherent in the use of conventional locking systems are overcome by the electronic security system according to the invention.

SUMMARY OF THE INVENTION

In the security system according to the invention, access to a room, for example, is controlled by a central control unit, located at the front desk, or at some other convenient location. The use of the modifier "central" with relation to the control unit does not necessarily mean that the control unit is physically centrally located with respect to the building, but rather that the control unit is electrically central to the security system. On registering, a guest is given one of a group of small data-bearing room access devices. It will be appreciated that such a device may be of any convenient shape or manufacture, the only requirement being that the device be capable of containing coded information which may be sensed electronically, magnetically, optically, etc. For psychological reasons, however, where the security system is used in a hotel, it may be desirable to have the device in the form of a key, since hotel guests are accustomed to the use of keys.

The key for use in gaining access to any given room is selected upon registration at random from the group of keys, each key in the group having a unique set of coded information to distinguish it from other keys in the group. Before giving the key to the guest, the clerk puts the key into a key code programmer, and the room number assigned to the guest is also entered in any suitable manner, such as by means of pushbuttons. The

programmer unit is equipped with means to sense the coded information on the key and to enter the code from the key inserted into it into the memory location in the central control unit which corresponds to the room number assigned to the guest. A person wishing to gain access to a room puts his key into a key reader outside the room door. This reader reads the code from the key and transmits it to the central control unit, where it is compared with the code previously assigned to the particular room.

If the codes match, the central control unit transmits a confirmation signal, which in the preferred embodiment effects release of the door latch, allowing access to the room.

The code for any particular room is stored in the predetermined memory location until such time as it is removed. This is accomplished by assigning a different key to this room, the computer being programmed to remove the previously stored code before entering the code contained on the different key. Where a room is to remain vacant, a particular one of the data group of keys is inserted into the key code programmer, this key containing a code which effects removal of the stored code from the predetermined memory location assigned to the room and leaves that memory location blank.

In addition to this, the basic system may be modified or augmented. For example, data-logging equipment could be attached to the central control unit to compile any required statistics.

Other objects and features of novelty will be apparent from the description of those embodiments of the invention which are described with reference to the accompanying drawings.

SUMMARY OF THE DRAWINGS

- FIG. 1 is a block diagram of a security system according to the invention;
 FIG. 2 shows a key for use in the system;
 FIG. 3 is a block diagram of a key code programmer;
 FIG. 4 is a schematic diagram of a key reader unit;
 FIG. 5 is a schematic diagram of a central control unit;
 FIG. 6 is a diagram of the locking mechanism employed in the system;
 FIG. 7 is a diagram of the control unit panel, and
 FIG. 8 is a diagram of one of the blocks contained in the panel shown in FIG. 7.

DETAILED DESCRIPTION WITH REFERENCE TO THE DRAWINGS

The block diagram of the security system shown in FIG. 1 illustrates the inter-relationship between the various parts of the system. For simplicity and clarity three rooms only are shown, although it will be appreciated that the system could control any number of rooms. The control unit 1 is central to the system. Before giving a key to a guest, the clerk, via pushbuttons inserts the room number into the key code programmer unit 2, and inserts the key into means within the programmer unit which senses the coded information contained on the key. This information, plus the room number, is transmitted to the control unit 1, and is stored in a memory location corresponding to the room number.

To gain access to a room, a key is inserted into the key reader 3 associated with that room and conveniently located in the vicinity of the room, e.g., adjacent the door frame. The coded information contained on the key is transmitted to the control unit 1, where it is compared with the information contained in the memory location corresponding to that room number. If the two items of information match, the control unit 1 sends a release signal to the door release solenoid 4 which then effects release of the door latch, allowing access to the room. The optional data print-out unit 5 could be used to compile any statistical data desired.

FIG. 2 illustrates a possible key design for use in the system of FIG. 1. As was pointed out above, many different types of data-bearing devices could be used for this purpose. The key 10 in the example of FIG. 2 consists of a predetermined array of conducting slugs 9 mounted in a non-conducting body to provide electrical continuity from one side to the other. The key reader circuit (described below with reference to FIG. 4) senses the presence or absence of a slug in any particular location. In the key shown, the pattern used is a row-column configuration, the use of which enables large amounts of information to be contained on a small object. For example, the use of a five-row three-column pattern would permit the unique identification of 4,095 different rooms. It will be apparent to those skilled in the art that there are many other possible ways of arranging the information and of carrying the information on keys. For instance, the desired pattern could be arranged by punching holes through an opaque key body, the holes then being read optically using, say, a light source and photodiodes. Similarly, it is apparent that the key could be designed for "either way up" operation or "right way up" only.

In the preferred embodiment illustrated, the column 7 of slugs and holes identifies the class of key, (i.e., master, maid, guest) and the columns and rows 8 of slugs and holes contain the coded information identifying the particular key.

In FIG. 3 is shown a block diagram of a key code programmer 2. Before giving a key selected at random to a guest, the clerk inserts the key in the key data reader 11. This reader may be of any conventional design; for instance, it may include an array of contact points each in a separate electric circuit designed to be closed when a slug is inserted between the points, and thus being capable of determining either the presence or absence of a slug in each position of the array. The room number is punched on the pushbutton board 12, which may be of any conventional design, and transmitted into the register 14. Associated with this register may be a verify read-out 13 e.g., a panel which displays the information entered on the pushbutton board 12 to enable the information punched on the board 12 to be checked. The clerk next pushes the read command button 15 which initiates the operation of the computer. The computer 16 stores the key data received from the key data reader 11 into a memory location previously assigned to the room number contained in register 14, which is also transmitted to the computer. The particular choice of circuitry employed in any of the individual parts of the programmer is within the ordinary skill of the computer circuit designer and forms no part of the invention and need not be discussed further.

Shown in FIG. 4 is one possible circuit for use as a key reader 3. It will be appreciated that each door in the hotel will be equipped with one of these readers. In the circuit shown, when a key is inserted, the forward tip 6 of the key (see FIG. 2) closes contacts A. This places a d.c. voltage on one terminal of AND gate 18 which is "enabled" by the output of one-shot unit 54, thereby putting a d.c. voltage on the "request service" line 51, and also through the preset circuit 17, presetting the shift register 19 to register all 0's except a 1 in the first position. Switches $S_1, S_2, \dots, S_n$ are opened or closed, depending on the presence or absence of slugs in particular locations on the key.

Further discussion of this circuit is carried out with reference to FIG. 5, in which is shown a possible circuit for use as a central control unit. For simplicity, only three service request lines and associated circuitry are shown, although it will be appreciated that there would be such a line for each room. The computer 16 senses a d.c. voltage on one of the "request service" lines 51 through the OR gate 25, and sequentially examines the reader lines, using the device selectors 26, together with AND gates 57 and OR gate 59 to determine which reader is requesting service. The device selectors may be of any conventional design. Once the reader line carrying the d.c. voltage is located by its device selector 26 and its AND gate 57 the memory flip flop 58 associated with that line is toggled, thus closing the corresponding solenoid selector switch, S_a , the register input selector switch, S_b , and the clock output selector switch, S_c . At this time the computer interrogates the key reader which is requesting service by commanding the clock generator 27 to generate clock pulses in the form of keyed tones which are sent to the reader via the clock line 60. These keyed tones are demodulated in the clock tone demodulator 52, see FIG. 4, with the result that the input to the shift register 19 is in the form of clock pulses. The shift register 19 may be of any conventional design, for example, a series of set-reset flip-flops. A second output of the clock generator 27, in the form of pulses provides one of the inputs to the shift register 28, FIG. 5, which can be of any conventional design. The other input to shift register 28 is provided by the output of AND gate 53, through the appropriate key read-out line 51 and switch S_b . The AND gate 53 will conduct whenever one of AND gates 20 conducts, which occurs whenever a conducting slug is present in the associated switch S_n and the associated position in the shift register 19 is activated. The other input to the AND gate 53 is provided by the one shot unit 54, and the inverter 55. The one-shot 54 is toggled by the reception of the first clock pulse, and it remains toggled for a sufficient time to allow the complete transmission of all the data sensed on the key. For a key having a five-row three-column pattern, discussed above with reference to FIG. 2, it would be necessary to transmit 15 clock pulses to the key reader circuit to do this. Each time a conducting slug is sensed in a particular location an input signal is provided at shift register 28, through an AND gate 20, AND gate 53, key read-out line 51 and switch S_b . The presence of the slug would then be registered in shift register 28, and the information in the register will then be advanced by the receipt of the next clock pulse. Once all positions on the key have been examined, the data contained in the shift register 28 is transmitted into the computer 16.

The filters 56 prevent clock tones from leaking onto adjacent clock lines and causing unwanted interrogation of other key readers. Filter 61 prevents the clock tones from interfering with the operation of the logic circuits.

The computer 16 is programmed such that upon receipt of the data from the shift register 28, the computer compares the data with the stored data previously assigned to the room whose reader is being interrogated. If the two sets of data correspond, the computer 16 effects closing of switch S_d , thus completing a circuit through S_d , and S_a to the room unlocking solenoid (discussed below with reference to FIG. 6) for the particular room.

It will be apparent to those skilled in the art that additional features could easily be added to this system. For example where the key data did not correspond to the stored code an alarm signal could be activated. In addition the key reader circuit could be designed to partially "pop-out" the key when the code reading is complete, thus preventing repetitive unnecessary servicing by the computer. Also, a data print-out unit could be tied into the computer to allow statistical data to be compiled as or if required, for example, to record the time at which a particular door was unlocked, and by what class of key. When the computer has completed a key reading and has taken the appropriate action, it resets the memory flip-flop 58.

FIG. 6 illustrates an example of a locking mechanism for use with the system according to the invention. A person wishing to gain access to a room inserts a key 10 into the key reader 3 of that room. Providing it is an authorized key, door release solenoid 4, which is located in door frame 34, will be energized by a signal to withdraw bolt 35 from recess 36 in the edge of door 37. When the bolt is fully withdrawn from the door, a bolt-retaining latch 38 is moved by spring 39 into notch 40 of the bolt to retain the latter clear of the door. At the same time, button 42 which is connected to the latch, is moved outwardly to project a little from frame 34 towards the door. The door is now free to be opened. A door knob or handle 43 can be provided on the outer surface of the door, but it does not have anything to do with the releasing of the door.

When door 37 is closed, it engages button 42 and moves latch 38 out of notch 40 so that spring 44 moves bolt 35 back into the door recess 36 to lock the door.

Egress from the room is obtained by turning the inside door knob 45 which turns a cam 46 to move a spring-loaded rod 47. This rod projects into recess 36, and when moved in this manner, the rod shifts bolt 35 out of the recess until it is engaged by latch 38, thus freeing the door.

FIG. 7 illustrates a possible panel which could be located at the front desk and which would replace the present panel which holds room keys. On such a panel could be located a key data reader 11, a pushbutton board 12 and a read command button 15, all discussed above with reference to FIG. 3. The individual block 13, one for each room, could serve as a verify read-out unit. A group of keys could conveniently be located in a receptacle identified generally as 72.

In FIG. 8 is shown an enlarged drawing of an individual block 13 for use in the panel of FIG. 7. This block 13 would contain a room number 74, adapted to

be lighted whenever the associated number is entered via the pushbutton board, thus performing the verify read-out function. In addition, the block would contain a number of indicating devices, such as lamps 75.

These lamps could be used to indicate the type of key being inserted in any room door, whether improper entry was being attempted, and whether the room was in use or vacant. Other useful information could be displayed on these blocks as well. For instance, it would be possible to ascertain the location of the hotel cleaning personnel. As was discussed above with reference to FIG. 2, a column of slugs and holes 7 could be used to identify the class of key being used, i.e., master, maid, guest. As will be appreciated by those familiar with the hotel industry, it is necessary that a maid's key be capable of opening several rooms and the master key be capable of opening any room. It would be necessary, therefore, to provide several memory locations in the computer for each room, one for each class of key. On issuing a key to a maid, the key would be inserted in the key data reader 11 (discussed above with reference to FIG. 3) and the rooms to which access is to be allowed entered into the computer via the pushbutton board 12. A particular lamp on the verify read-out 13 contained on the panel at the front desk would then display the location of maids at any particular time.

We claim:

1. A security system for controlling access to a plurality of enclosures, comprising: a plurality of portable permanently coded data-bearing devices used in gaining access to the enclosures, each said device bearing a unique set of data represented by a non-magnetic coding pattern; a computer located at a central location and including a memory location dedicated to each of said plurality of enclosures; a programmer means located at the central location for, in cooperation with said data bearing devices, programming the data borne by said data bearing devices and enclosure identification data into said computer prior to use of the data-bearing device to gain access to a said enclosure, said programmer means comprising means for physically receiving individual ones of the said data-bearing devices and for sensing the data borne by a said data-bearing device received thereby so that the said data-bearing device provides data used in programming the computer, and means for entering enclosure identification data for each enclosure into said programmer means; read-out means for controlling reading out of data from said programmer means when the data borne by a said data-bearing device is sensed by said data-bearing device receiving means and enclosure identification data is entered into said programmer means; means for connecting the output of said programmer means to said computer to provide storage the data read out of said programmer means so that the sensed data borne by the said data-bearing device received by said data-bearing device receiving means is stored at an enclosure dedicated memory located within said computer in accordance with the enclosure identification data contained in said read out data; a locking means, for and at each enclosure, for normally locking that enclosure; lock release means associated with each said locking means for controlling release of said locking means; reader means located at each enclosure for receiving the said data-bearing devices, for sensing data

borne by the received data-bearing devices and for producing an output in accordance with the data sensed; means for connecting the outputs of each said reader means to said central computer, said computer acting to identify the sensed data output received from a said reader means with the corresponding enclosure, to compare the sensed data received from that reader means with the corresponding data stored at the memory location dedicated to the corresponding enclosure, and to produce an output signal for actuating the lock release means of said corresponding enclosure so as to release the locking means associated therewith to thereby unlock said corresponding enclosure, when the sensed data and the corresponding data match.

2. A security system as claimed in claim 1 wherein said reader means includes means for transmitting a "request service" signal to said computer, said computer transmitting a release signal to said lock release means when the sensed data received from the reader means matches the corresponding data stored at the memory location dedicated to the enclosure associated with that reader means.

3. A security system as claimed in claim 1 in which at least some of the data-bearing devices include additional data for uniquely identifying the respective data-bearing devices to the computer.

4. A security system as claimed in claim 1 in which, when a data-bearing device is received by the programmer means and identification data for an enclosure is entered into the programmer means, said data-bearing device cancels any previous data in the computer memory section dedicated to the identified enclosure.

5. A security system as claimed in claim 1 including a data-bearing device with data thereon which when said device is inserted into the programmer means and the identification of an enclosure is inserted into said programmer means, cancels any previous data in the computer memory section dedicated to the identified enclosure and leaves the latter section blank.

6. A security system as claimed in claim 1 including a data display unit adapted to display information trans-

mitted to it by the computer.

7. A security system as claimed in claim 1 in which each data-bearing device comprises a plurality of spaced-apart conducting slugs extending through a non-conducting body and arranged in a predetermined pattern, the pattern of each device being different from the patterns of other similar devices.

8. A security system as claimed in claim 1 including a means associated with the programmer unit for indicating the enclosure identification inserted in said programmer means.

9. A security system as claimed in claim 1 in which said programmer means includes a register for receiving the enclosure identification, and said read out control means comprises means for initiating the operation of the computer to cause the storage of any data being sensed by the programmer unit in the computer memory section dedicated to the identified enclosure.

10. A security system as claimed in claim 9 including a means associated with the programmer unit for indicating the enclosure identification inserted into said register.

11. A security system as claimed in claim 1 in which the computer has a plurality of memory sections dedicated to each enclosure, and at least some of the data-bearing devices include additional data for identifying the respective data-bearing devices to the computer, said additional data being stored in a different memory section for each enclosure from the memory section in which the first-mentioned data is stored.

12. A security system as claimed in claim 2 including an alarm which is activated upon receipt of a signal from the computer indicating that the data being compared in the computer does not match.

13. A security system as claimed in claim 2 in which said lock release means includes a solenoid connected to the computer, said solenoid being energized by said signal from the computer to unlock said locking means.

14. A security system as claimed in claim 13 wherein said locking means comprises a bolt controlled by said solenoid.

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