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Resnick et al.

[11] **3,787,714**

[45] **Jan. 22, 1974**

[54] **ELECTRONIC LOCK AND KEY SYSTEMS EMPLOYING PAIRED KEY AND MASTER CODING MODULES**

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[73] Assignee: **said Sam L. Resnick, by said Stephen Berens**

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[21] Appl. No.: **283,846**

[52] **U.S. Cl.** ..... **317/134**, 340/147 MD

[51] **Int. Cl.** **E05b 49/00**

[58] **Field of Search** . 317/134; 340/147 R, 147 MD, 340/149

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Primary Examiner—J. D. Miller

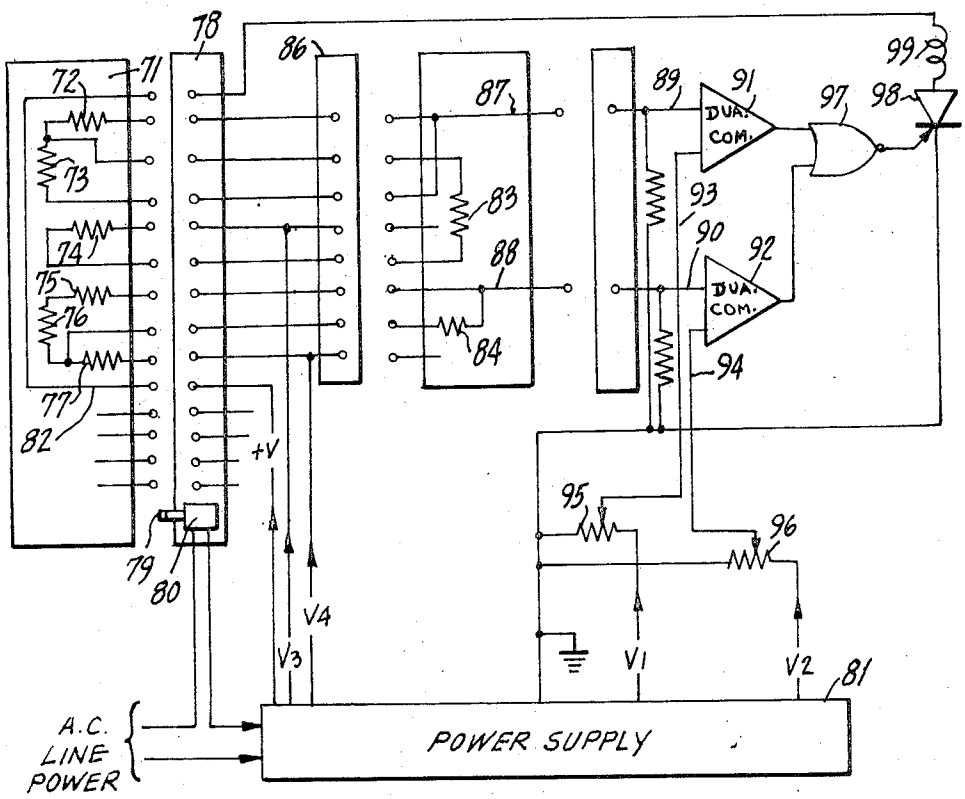
Assistant Examiner—Harry E. Moose, Jr.

[57] **ABSTRACT**

There is disclosed an electronic key and lock system for activating an electric latch when a valid key is inserted into a key receiving receptacle. The system is energized by the insertion of the key into the receiving receptacle to energize both the key and a master coding card to cause a correlation sequence to be implemented to determine whether information contained on the key is valid by comparing this information with predetermined information on the master coding card.

Various embodiments utilize key cards having light accommodating apertures operative in conjunction with photodetectors, key cards having electrical components operative in conjunction with voltage comparators and cards employing frequency determining elements.

8 Claims, 9 Drawing Figures



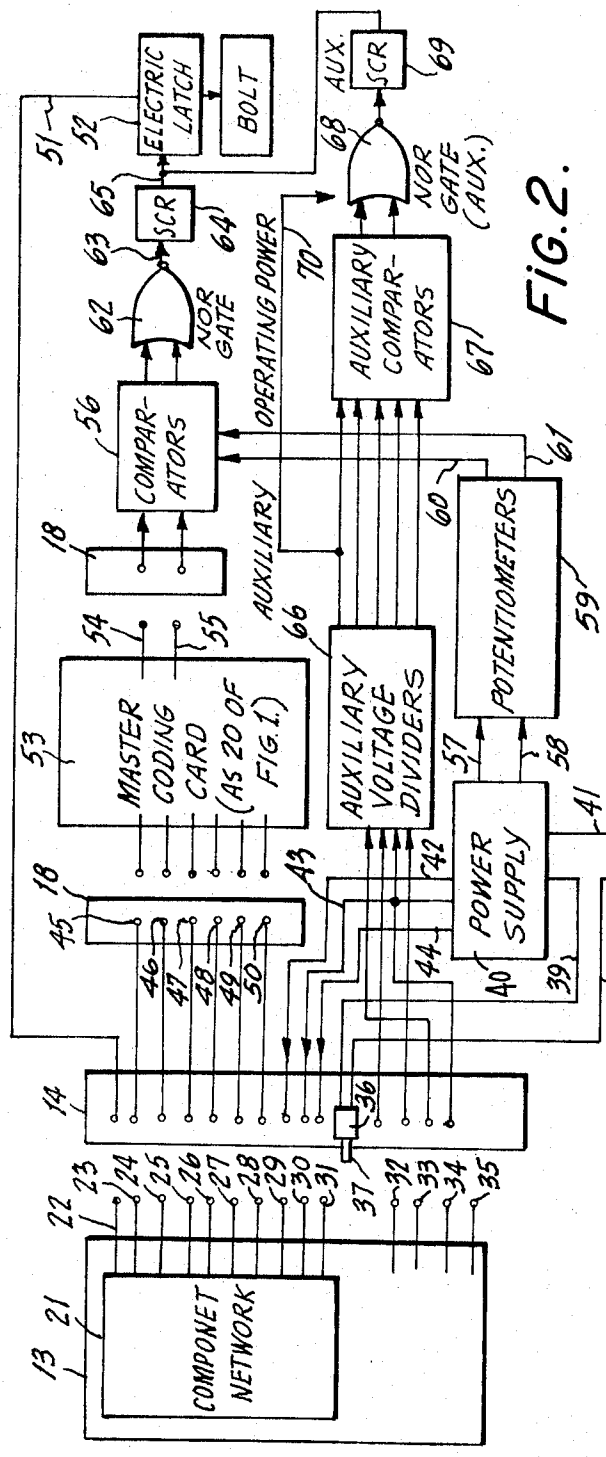

ELECTRIC LATCH
BOLT
AUX. SCR
NOR GATE (AUX.)
SCR
NOR GATE
COMPAR-ATORS
OPERATING POWER
AUXILIARY COMPAR-ATORS
AUXILIARY
MASTER CODING CARD (AS 20 OF FIG. 1.)
AUXILIARY VOLTAGE DIVIDERS
POTENTIOMETERS
POWER SUPPLY
A.C. LINE POWER
COMPONET NETWORK

FIG. 2.

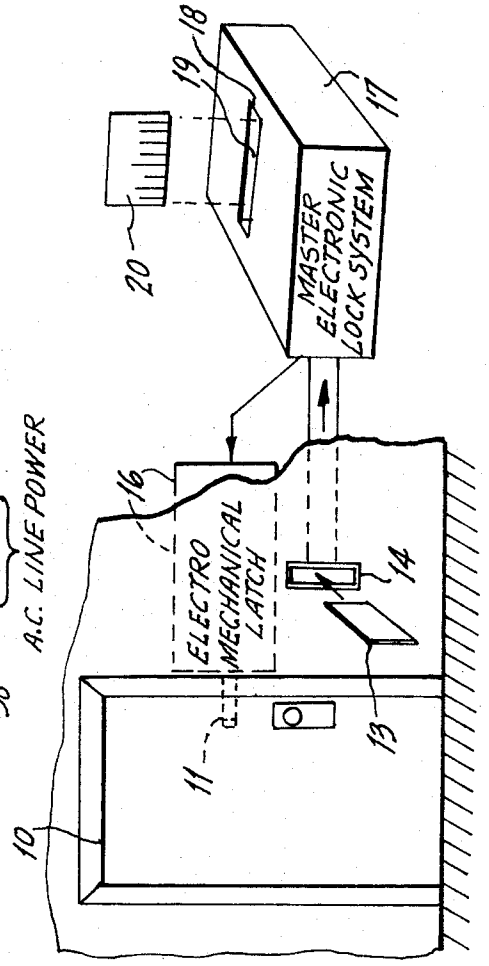
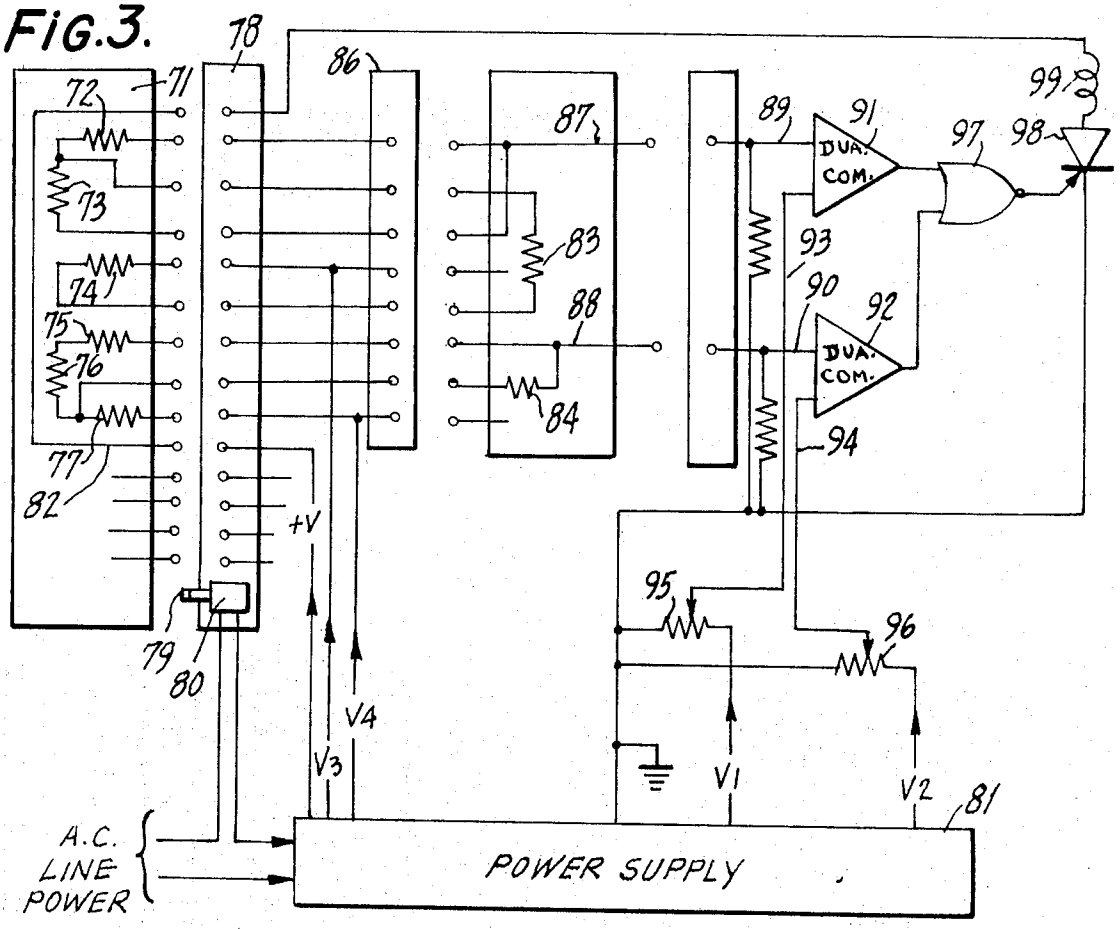

MASTER ELECTRONIC LOCK SYSTEM
ELECTRO MECHANICAL LATCH

FIG. 1.

FIG. 3.


78
86
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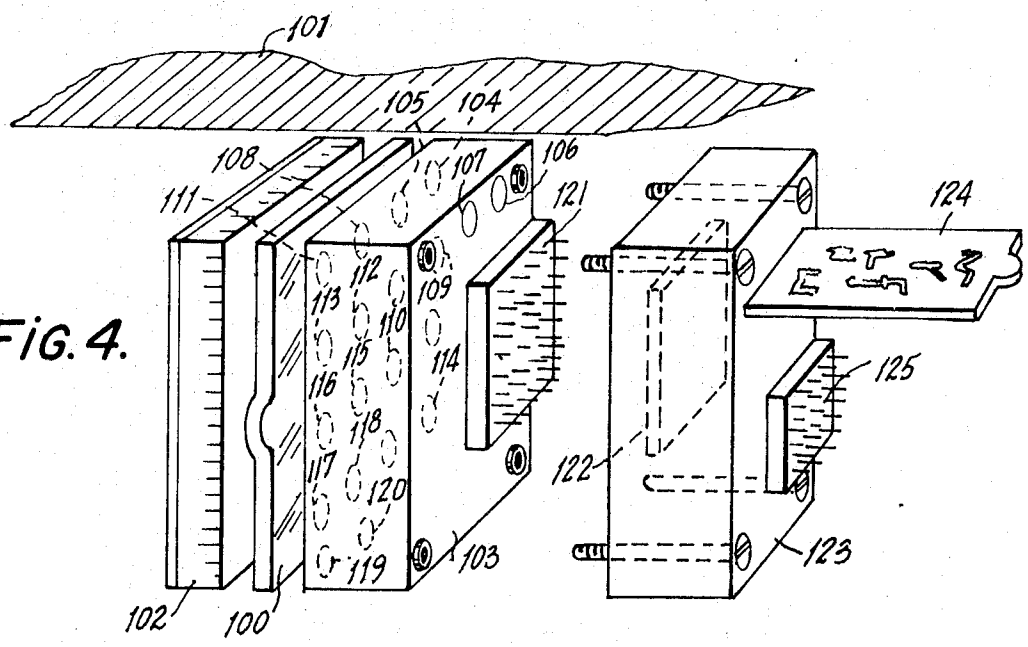
82
87
83
88
84
89
91
DUA. COM.
97
98
99
93
90
92
DUA. COM.
94
+V
79
80
V4
V3
95
96
V1
V2
81
A.C. LINE POWER
POWER SUPPLY

FIG. 4.


101
105
104
108
106
107
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124
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125
122
123
102
100

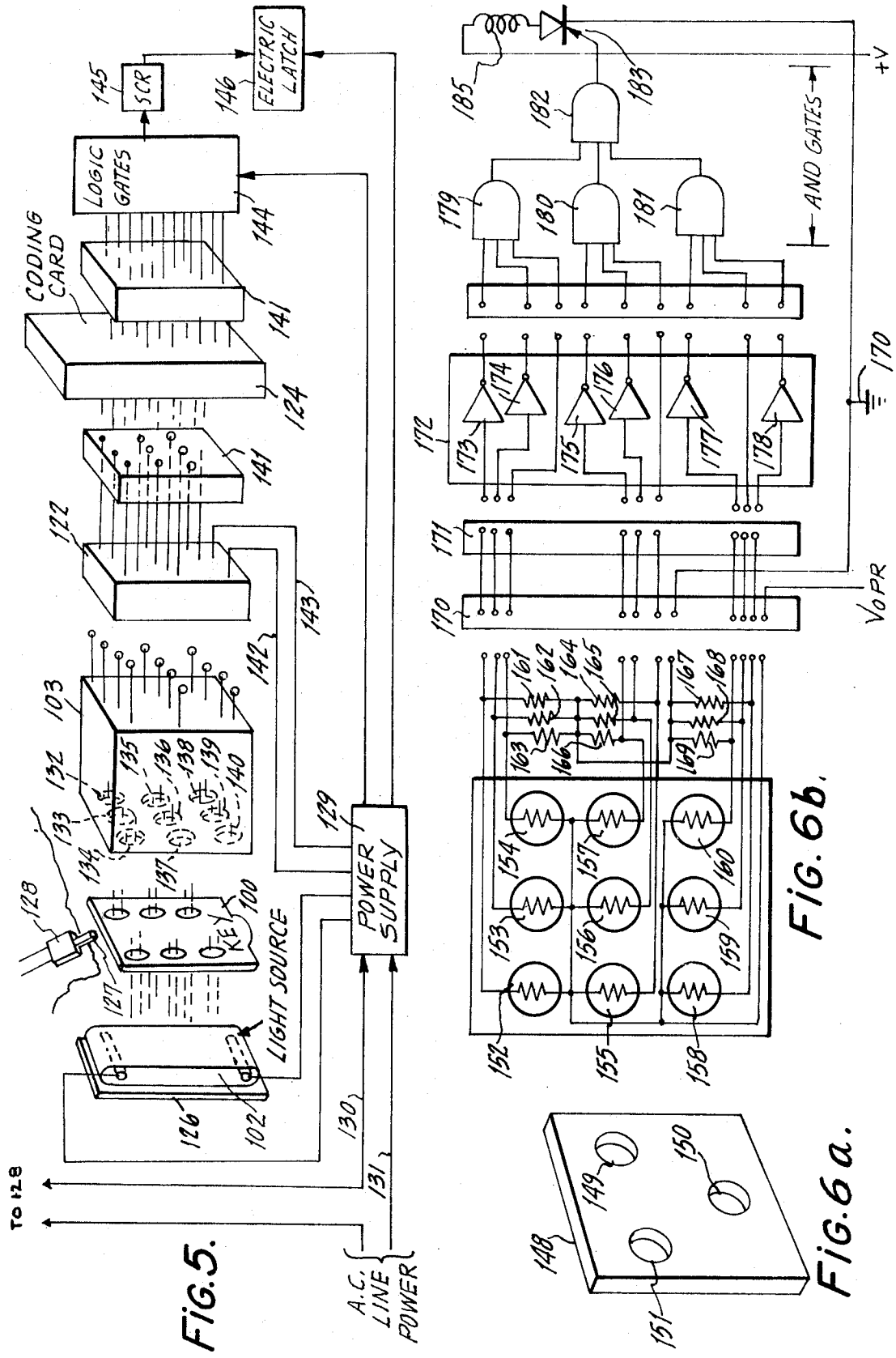

Fig. 5.

Fig. 6b.

Fig. 6a.

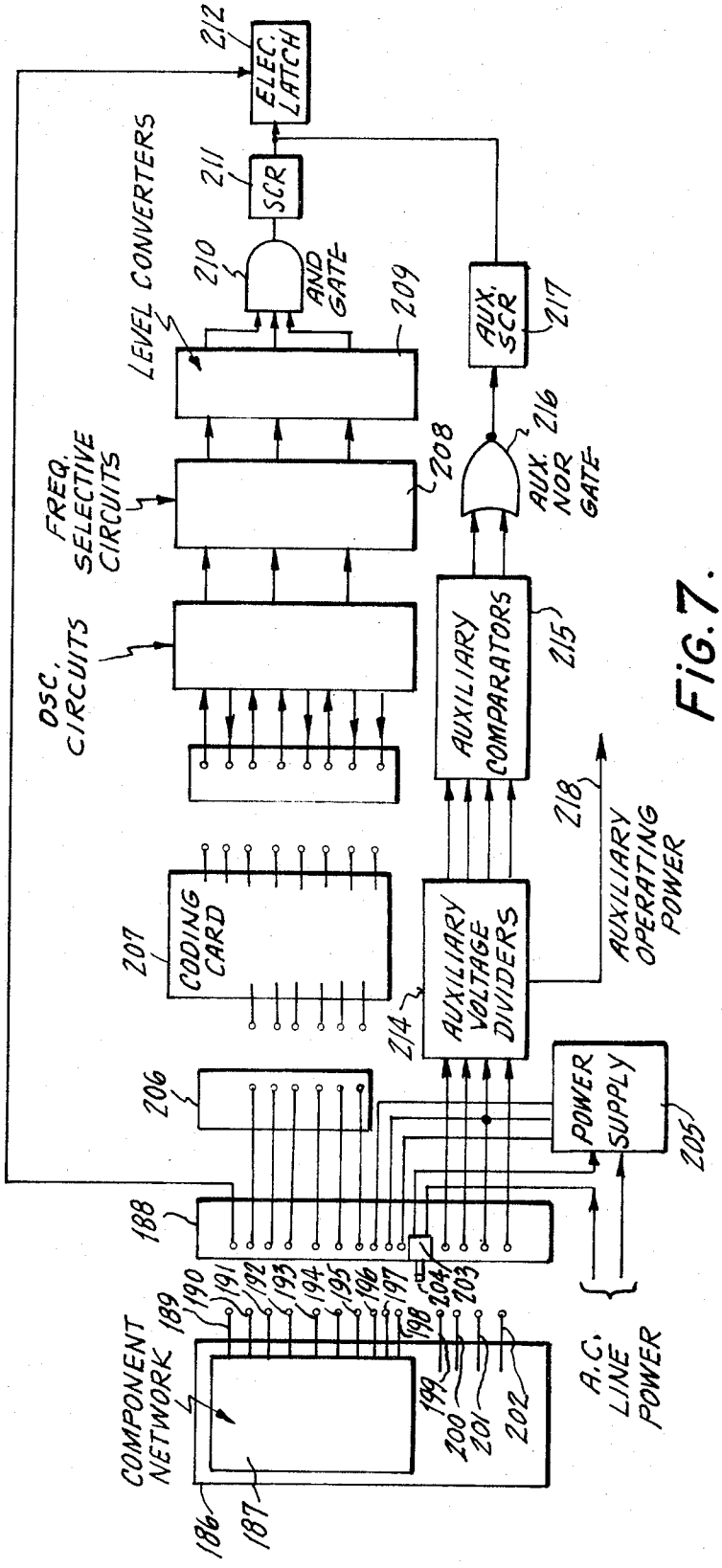
212
ELEC. LATCH
211
SCR
210
AND GATE
209
LEVEL CONVERTERS
208
FREQ. SELECTIVE CIRCUITS
OSC. CIRCUITS
217
AUX. SCR
216
AUX. NOR GATE
215
AUXILIARY COMPARATORS
218
AUXILIARY OPERATING POWER
207
CODING CARD
214
AUXILIARY VOLTAGE DIVIDERS
206
POWER SUPPLY
205
188
189
190
191
192
193
194
195
196
197
198
204
203
199
200
201
202
A.C. LINE POWER
COMPONENT NETWORK
186
187

FIG. 7.

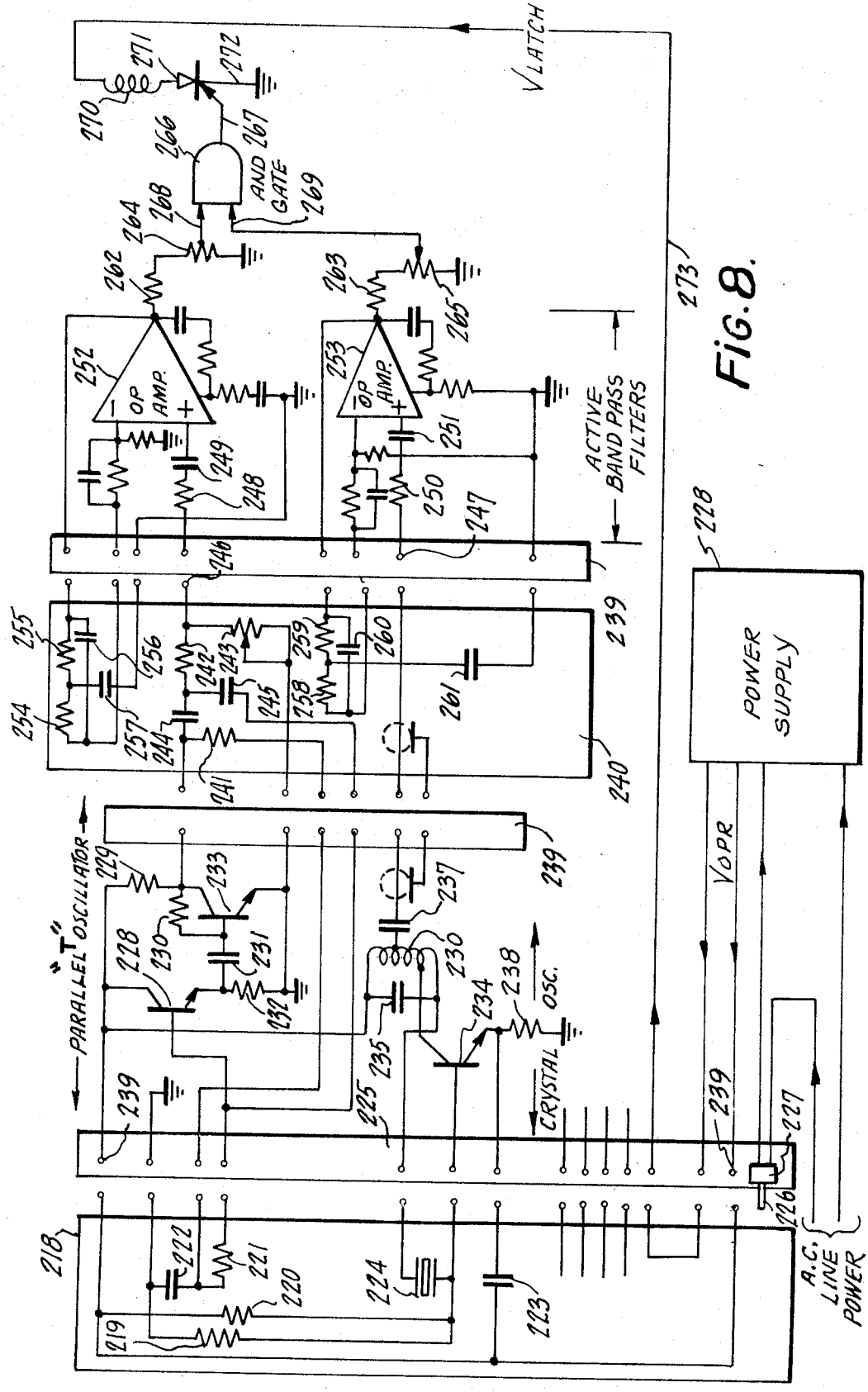
V LATCH
AND GATE
OP AMP.
ACTIVE BAND PASS FILTERS
POWER SUPPLY
V OPR
"T" PARALLEL OSCILLATOR
CRYSTAL OSC.
A.C. LINE POWER

Fig. 8.

ELECTRONIC LOCK AND KEY SYSTEMS EMPLOYING PAIRED KEY AND MASTER CODING MODULES

BACKGROUND OF INVENTION

This invention relates to a lock apparatus and more particularly to an electronically operated lock and key, capable of accommodating a number of different control combinations.

Basically the prior art is replete with a great number of patents directed towards electronic lock and key assemblies. The advantage of electronic locks over their mechanical counterparts are relatively obvious in that electronic lock assemblies offer greater protection in guarding against unauthorized entry, key duplication or "lock picking."

In recognizing the advantages of using electronics in this art area, the prior art envisioned various schemes, which essentially provided a control electronic assembly which operated a solenoid or electromechanical latch when the correct circuit key was inserted into the assembly. The control assembly served to implement a predetermined sequence under control of the key, which sequence if correct, caused the control unit to activate the latch thus permitting access to the secured area.

Such control assemblies employ various electrical and magnetic coding schemes, such as pulses codes, binary codes, selective frequency determination and so on, to determine correlation between the predetermined condition and the particular key arrangement.

The major disadvantages of such electronic or magnetic locking systems resides in the fact that the control units or those units associated with the door latch exhibit a fixed response characteristics operated only by a single coded key.

In order to implement a combination so that the door or control unit can be accessed by other keys, rewiring, component changes and so on are necessary. Still other prior art systems cannot without extensive redesign of the systems accommodate a plurality of different keys simply, reliably and economically.

This particular feature is of prime importance in certain business activities, such as hotels, motels and so on. In the operation of such establishments, which cater to guests and in general to the transient trade, keys are exchanged thousands of times a year. Such keys are stolen, lost or misplaced, and as such an unauthorized person possessing such a key would have direct access to the premises. Due to these factors such establishments suffer huge losses in regard to stolen property and vandalism.

It would therefore be advantageous to provide a key and lock assembly which would be difficult to pick, be secure and further possess the characteristic of being easily changed on a daily or a more frequent basis. This being necessary to eliminate the problem of unauthorized access as described above.

BRIEF DESCRIPTION OF PREFERRED EMBODIMENT

A new and improved electronic lock and key system of the type for providing an actuation signal operative to energize an electric latch to permit access to a secured area, comprises a key card having a plurality of terminal areas on an appropriate edge; the key card

further containing predetermined electrical information in a given format; a master coding card has a number of terminals associated therewith and has located thereon electrical information substantially correlated to said information on said key card, said terminal receptacle means including means for energizing said key card and said master coding card to cause said respective information to be compared by providing a comparison signal and activation means coupled to said latch and responsive to said comparison signal for operating the latch to permit access to said secured area only when said information on said key card correlates with said information on said master coding card.

BRIEF DESCRIPTION OF FIGURES

FIG. 1 is a block diagram showing a secured door and including an electronic lock and key apparatus according to this invention.

FIG. 2 is a detailed block diagram showing an electronic lock and key configuration according to this invention.

FIG. 3 is a detailed schematic diagram of an embodiment according to FIG. 2.

FIG. 4 is a perspective view of a lock and key arrangement utilizing electro-optical techniques.

FIG. 5 is a partial perspective and block schematic in greater detail of the embodiment shown in FIG. 4.

FIGS. 6A and 6B show a perspective view of a card and a schematic diagram of detecting apparatus utilized with the key card.

FIG. 7 is a detailed block diagram of an electronic key and card assembly using frequency selective principles.

FIG. 8 is a circuit schematic of the apparatus according to FIG. 7.

DETAILED DESCRIPTION OF FIGURES

Referring to FIG. 1, there is shown a door 10 which may be an enclosure entrance to a room in a motel or hotel or some other secured area. The door 10 can be opened if the retractable bolt 11 is withdrawn from a locking position (shown dashed) to an opening position. The retractable bolt 11 may by the plunger of a solenoid or may be coupled to a suitable electromechanical device as a motor and so on by means of a mechanical linkage. The function of the bolt 11 being to provide a first door restraining or locking position and a second door opening or access position. The operation of the bolt 11 is under the control of an electromechanical latch assembly 16, this assembly may contain a motor and mechanical linkage to afford the desired movement to the bolt 11.

The electromechanical latch assembly 16 is controlled by means of a master electronic lock system 17. The system 17, as will be described in greater detail, contains logic or other circuitry which performs a predetermined sequence of steps capable of ascertaining whether an associated key 13 inserted into the slot 14 is valid. If validation is determined, the system 17 operates the bolt 11 via the latch 16, to withdraw the bolt from the door, thus permitting entry therethrough.

To implement operation of the bolt 11, a component key receptacle 14 is shown. The receptacle 14 is designed to accommodate a key card 13, which, as will be explained, has located thereon a circuit format, capable of causing the master lock system 17 to validate the

card and therefore energize the bolt **11**, only for insertion of the correct key card **13** into slot **14**.

Essentially the key card **13** coacts with a terminal board or contact assembly positioned within key receptacle **14**. The terminal or contact assembly is electrically coupled to the master electronic lock system **17** by means of wires or otherwise. Also shown located on a surface of the lock system **17** is a receptacle **18** having a card accommodating slot **19**. Into this slot is inserted a master coding card **20**, which functions as the main validation means for verifying that a correct key card **13** was inserted into receptacle **14**. The master coding card **20** can therefore be easily removed and replaced at the whim of the operator of the establishment and can therefore provide a plurality of different locking combinations solely dependent upon the nature and characteristics of the master coding card **20** and its associated key card **13**.

In regard to physical location, the electronic lock system **17** is placed within the confines of the room or area associated with door **10**, or at some master location within the building, strictly under control and access of the operator of the establishment.

In this manner, after a guest checks out, the manager merely changes the master coding card **20** simultaneous with the preparation of the room for a new guest. When the new guest arrives, he is given a new appropriate key card **13**, to correlate with the master coding card **20**. In regard to such procedures, it can be seen that keys or key cards can be supplied to guests on a random basis and the same key card need not ever be used to activate the same locking mechanism associated with a particular door. While, of course, the utility of such arrangements have been described in conjunction with motel and hotel security, it will be apparent that various other establishments and systems would also require the apparatus to be more fully described.

Referring to FIG. **2**, there is shown a detailed block diagram of a key card assembly (as **13** of FIG. **1**), a master electronic lock system (as **17** of FIG. **1**) incorporating a master coding card (as **20** of FIG. **1**).

As shown in FIG. **2**, the key card **13** may include a component network **21**, which network includes one or more electrical components as resistors, capacitors, inductors and so on. The key card **13** has located on an edge thereof a plurality of terminals designated as **22** through **35** respectively. It is understood that the exact number of terminals are not important as more or less could be employed. It is, however, noted that the component network does not necessarily interface or couple to all the existing terminals **22** to **35** as located on the card assembly **13**.

The terminal assembly of card **13** is adapted to coact with the card accommodating receptacle (**14** of FIG. **1**) which as previously explained is located and associated with the master electronic lock system. The receptacle **14** has a corresponding terminal for each terminal **22** to **35** located on card **13**.

There is also shown a switch **36**, which has a moveable plunger or actuator arm **37**. The function of the switch is to supply power to the lock system only upon insertion of the key card **13** into the card accommodating receptacle **14**.

For example, as is schematically shown in FIG. **2**, one conductor **38** of the AC lines **38** and **41** (120 volts, 60 Hz or other) is directed through switch **36**, which is normally opened. As the card **13** is inserted, the edge of the card **13** activates the plunger **37** causing AC to be applied to the power supply module **40**. Therefore, as long as a card **13** is coacting with receptacle **14** switch **36** is operated to supply prime (AC) power to power supply **40**.

As can be seen, lines **42**, **43** and **44** emanate from the power supply **40** and are coupled to appropriate terminals of receptacle **14**, which is in this instance corresponds with terminals **29**, **30** and **31** of key card **13**. The circuit components contained in network **21** (as resistors) therefore respond to these applied voltages and the altered voltages due to the action of the network are in turn applied to contacts **23** through **28**. It is seen that once the card **13** is inserted into receptacle **14**, the contacts **23** through **28** are directly wired to another receptacle or terminal assembly **18** and thereby directly interface with terminals **45** to **50**. Terminal **22** is directed via the receptacle **14** directly to the electric latch **52**, to therefore assure that operating potential is available at the latch **52** when a card is inserted.

The master coding card **53** (**20** of FIG. **1**) is inserted into receptacle **18** and has terminals thereon which directly interface with terminals **45** to **50** of receptacle **18**, and therefore terminals **23** to **28** of card **13**.

Briefly, but as will be explained in greater detail, the master coding card **53** is matched to the key card **13** and is arranged to process the altered voltages developed by the component network **21** to predetermined voltages at the output terminals **54** and **55** of the master coding card **53**. These predetermined voltages are applied to voltage comparator circuits **56**. The comparators **56** also receive standard comparision voltages from the potentiometer module **59**. Module **59** contains a number of variable elements which are energized by lines **57** and **58** emanating from the main power supply module **40**. The potentiometers are used to establish reference voltages for the comparators **56**. These reference voltages are compared with the master coding card processed levels, and if they compare within predetermined tolerances, the comparators **56** will supply an activating signal to NOR gate **62**. Gate **62** in turn triggers a silicon controlled rectifier or SCR **64**, which in turn activates the electric latch **52** and the associated bolt to the door opened position.

This therefore releases the bolt and permits entry to the room via door **10** of FIG. **1**.

As can be seen, power is supplied by means of power supply **40** to the entire unit, i.e., comparators **56**, key card **13**, master coding card **53** and so on. Therefore, without further structure, a power failure would cause the entire lock system to become inoperative.

The unit contains a series of auxiliary voltage dividers **66** which have inputs coupled to receptacle **14** at those terminals corresponding to the unused terminals **32**, **33**, **34** and **35** of key card **13**.

These terminals are associated with a special key card **13** for use only during such a powerful failure by the management or authorized personnel.

The special key card contains a source of power as a battery. When the special card is inserted, the battery energizes the auxiliary voltage dividers **66**, the auxiliary comparators **67**, the auxiliary NOR gate **68** and the auxiliary SCR **69**.

The auxiliary SCR **69** is also coupled to the electric latch **52**, to activate the same and therefore release the bolt.

This structure specifies operation during power failure and enables supervisory personnel to gain access to the enclosure or room protected by the lock system. It is also noted that the special key and associated auxiliary circuit arrangements enable operation of the lock if there is a component failure in the main assembly, such as a failure of NOR gate 62 and so on.

This, of course, provides redundancy and enables back-up operation for such contingencies.

Referring to FIG. 3, there is shown a more detailed schematic diagram of a locking system according to this invention. Numeral 71 references a key card which employs a series of resistor networks located on the surface thereof. Alternatively, key card 71 can employ integrated circuit techniques wherein the resistor would be imbedded in the card or diffused. The resistors such as 72 and 73 form a voltage divider network. The junction between resistors 72 and 73 is coupled to a separate terminal on connector 78 which connector performs a similar function as connector 14 of FIG. 2. An additional resistor 74 is also shown, as is another voltage divider comprising resistors 74, 75, 76 and 77. It is seen that the junction between resistors 76 and 77 is also coupled to a separate terminal which is associated with an appropriate terminal on connector 78. There is also shown the power supply activating switch 80 having a movable plunger 79 which serves to couple power to power supply 81 upon activation of the switch 80. It is also understood that while resistors are shown employed upon the key card 71 other components and combinations such as capacitors, semiconductors and so on could be utilized as well. The resistors as 72 to 77 as contained upon the card are oriented in a desired sequence which sequence has been predetermined and preset.

When the key card 71 is inserted in the receptacle 78, the power supply 81 is thus activated and operating voltages (schematically designated as +V, V3 and V4) are applied to the key card via receptacle 78. The voltage dividers comprising the resistors 72 to 77 modify these voltages according to their predetermined voltage division ratios. The action of the voltage dividers cause predetermined fixed voltages to be applied to lines 87 and 88 which lines are associated with and are contained upon the master key card 85. The output lines 87 and 88 coact with appropriate mating lines 89 and 90. It is first noted that resistors 83 and 84 on the master coding card 85 further modify the voltages before application to the dual comparator circuits 91 and 92. The comparators also have resistors in conjunction with their inputs as designated by numerals 89 and 90 which resistors further modify the voltages applied to the appropriate terminals. In this instance, the application of the voltages from the key card 71 and thence from the master coding card 85 are applied to the inputs of the comparators 91 and 92. The function of dual comparators 91 and 92 and circuits for such devices are well known in the art. Such dual comparators can be purchased as operational amplifiers or other suitable integrated circuit devices. The dual voltage comparators 91 and 92 also receive reference voltage inputs to their alternate inverting and non-inverting inputs designated as 93 and 94 from two potentiometers 95 and 96. The potentiometers receive operating potential designated as V1 and V2 from power supply 81. The dual voltage comparators 91 and 92 operate as follows: If the voltages applied to the dual comparators equal the reference voltages supplied by potentiometers 95 and 96, the comparators will supply a near zero or ground output voltage. If both voltages from both dual comparators 91 and 92 are at a low value, the output of gate 97 goes high. This high voltage enables the SCR 98. The anode of SCR 98 is coupled through a coil 99 which is the activation coil of the electric latch or solenoid device. This device directly operates the bolt as associated with the secured door. It is also shown that one terminal of the coil 99 goes directly to a terminal on connector 78 which terminal receives power from power supply 81 via the key card 71 by means of the energizing line 82. Thus, if the voltages at the inputs of the comparators correlate with the voltages supplied by the reference source, the SCR 98 will trigger and remain energized until the key card 71 is removed from the receptacle 78.

FIG. 4 shows an alternate embodiment of a key card and a coding card arrangement. The embodiment of FIG. 4 uses light sensitive devices. In this particular arrangement, a key card 100 is fabricated from a thin plastic or other type of material. On the surface of the material 100 then exists a number of different locations for different degrees of transparency. For example, the key card 100 may exactly consist of a film negative having certain areas which are light transmitting and other areas which are opaque. In a similar manner, the card 100 may be an opaque piece of plastic with holes punched or apertures located on the surface at predetermined locations. The card 100 is inserted into a slot as shown in the Figure. Insertion of the card activates a light source 102. The light source typically emits a uniform area light which is directed at the card 100. For example, at the transparent area of the card, light will shine through or pass through and impinge upon the surface of a bank of photo cells which are contained in module 105. These photo cells typically designated as 104 through 120 respond to the intensity of the light allowed to propogate through the card 100. Typically, a photo cell will decrease its resistive value upon illumination. As indicated in conjunction with FIG. 3, this change in resistance can alter the character of a voltage device or other circuit element in a predetermined manner. The bank of photo cells 105 is coupled to a connector 121. Also coupled to connector 121 there is shown a master coding card 124 which is inserted into a module 123. This master coding card as previously indicated is matched to the electronic key card 100 and supplies suitable information to indicate to circuit components, such as comparators, that correlation has been made and the correct card 100 has been inserted. This would therefore cause the unlocking of the door by means of an electromechanical device as previously indicated.

Referring to FIG. 5, a more detailed schematic of a light sensitive key and lock configuration is shown. The light source 102 has a mirror surface 126 as a backing thereof. The light source employed can be conventional bulbs, neon devices or light emitting diodes. The mirror surface 126 serves to reflect light from the source towards a plurality of photosensitive devices mounted in a detector module 103. There is shown a key card 100 having a plurality of light emitting apertures located on the surface thereof. The key card 100 may be selectively inserted between the light source 102 and the photodetector module 103. Upon insertion of the key card 102 into an appropriate slot, the

plunger 127 of switch 128 is depressed which serves to supply power to the power supply module 129. The operation of the switch 128 operates the light source and the detector circuitry. The detector circuit 103 may employ a plurality of light detecting devices 132 to 140. These devices may be photocells or photosensitive resistors and as they are selectively illuminated due to the particular card format, their currents or voltages vary depending upon the circuit configuration they are included in. These photocell currents, as determined by the light intensity, are applied to the master coding card 124 via the connector assemblies 132 and 141. The master coding card 124 may comprise a series of wire connections or circuit elements that are picked according to the particular format of the key card 100. In this manner, as indicated previously, the coding card 124 and the key card 100 are matched. Therefore, if one desired to change the operation of the lock associated with any particular door, one merely would change the key card 100 and the master coding card 124. The master coding card interfaces with a series of logic gates 144. These gates are set up in a typical decoder circuit to assure correlation between the coding card connections and the key card to thereby activate the SCR 145 when a proper match is afforded. Activation of the SCR 145 serves to operate the electric latch 146 thus providing admittance to a particular secured location.

FIG. 6 shows a more detailed arrangement for a light sensitive lock assembly. FIG. 6A shows a typical card 148. The card 148, for purposes of this example, has three apertures 149, 150 and 151 located on a surface thereof. As indicated, the card may be fabricated from an opaque or non-light conducting plastic or other material. The apertures or holes may be punched or otherwise formed on the surface of the card. FIG. 6B shows a bank of photocells arranged in a rectangular matrix configuration. The photocells are numbered respectively as 152 through 160. It is immediately seen that as the card 148 is placed in front of these photocells and a source of light directed in front of the card, only certain of the photocells would be subjected to light. The other cells would not be exposed to light due to the fact that they would be blocked by the opaque portions of card 148. For example, for a particular configuration shown, only photocells 154, 155 and 159 would be illuminated. The resistance of these cells would decrease substantially while the resistance of the remaining cells would remain at a high value. Each photocell in the bank receives an operating voltage from a power supply (not shown). This operating voltage causes currents to flow through the photocells. The value of these currents depends upon whether or not the photocell is being illuminated and the degree of illumination. Each photocell has a ground return afforded through an associated resistor 161 to 169. As a photocell is being illuminated, then its resistance value is lowered causing a large voltage to appear across the associated resistor. The outputs of this circuit are taken from the resistors 161 to 169 and are applied to the connector 170 and thence to connector 171. A master coding card 172 contains a series of invertors or amplifiers 173 to 178. There is one amplifier for each photocell. The photocells that are illuminated provide a high voltage at the input of these amplifiers, which high voltage is inverted to a low voltage at the output of the amplifiers. In the above example, the photocells 154, 155 and 159 are illuminated. Amplifiers 174, 176 and 177 then provide a low voltage at their outputs. The low voltages cause the gates 179, 180 and 181 to change logical states. The outputs of these gates 179 through 181 are coupled directly to gate 182. Therefore, gate 182 has three simultaneous inputs all at the high level. Gate 182 then proceeds to triger the SCR 183. The SCR 183 is in series with a coil 182 associated with the electromechanical latch and therefore this latch is energized and thus causes the secured door or area to open by moving a bolt to the door-opened position.

Thus far there has been shown a key card which includes electrical components as resistors and operated to alter the voltage or current. There has also been shown a key card and lock assembly which uses light sensitive devices and operates with a resistor change to thereby afford a voltage or current change. It is also obvious to one skilled in the art that many additional components and circuits may also be used in lieu of those shown above without departing from the scope and concept of this invention.

For example, now referring to FIG. 7 there is shown an electronic key and lock assembly which operates on the basis of comparing frequency. A key card 186 contains a component network 187. Associated with the card 186 are electrical contacts 189 to 192 adapted to coact with a key card accommodating receptacle 188. The receptacle 188, as previously described, coacts with the receptacle 206. The receptacle 206 is adapted to receive the master coding card 207 and has its output coupled to an oscillator circuit card 207. The output of the oscillator circuit card is applied to a frequency selective card 208. The output of the circuit card 208 is applied to level converter card 209 which is coupled to an AND gate 210. The output of the AND gate 210 is coupled to a SCR 211 which is in series with an electric latch 212 adapted to operate a solenoid or other device to allow the opening of a door. The circuit shown in FIG. 7 also includes auxiliary voltage dividers and comparators 214 and 215 as well as an auxiliary gate 216 and SCR 217 to enable operation of the lock during a power failure or a component failure. This operation, as has been previously described, is afforded by means of a special key card which the operator can insert into receptacle 188 and which key card is especially adapted to coact with terminals 199 to 202 of receptacle 188. This feature provides power failure operation as well as operation in the case of a component failure.

Referring to FIG. 8 a detailed schematic of a frequency selective circuitry particularly as shown in FIG. 9 is presented. The key card 218 is shown (as 186 of FIG. 7) including a number of circuit components and a piezo-electric or quartz crystal 224. Such crystals are capable of producing very precise frequency signals upon activation of such crystals in a suitable circuit. Also shown on card 218 are additional components including capacitors 222 and 223 and a number of resistors 219 to 221. The key card 218 has a series of terminals on a suitable edge which is designed to coact with receptacle 225. Upon insertion of the card 218 into receptacle 225, power is applied to the system as previously described via switch 227. There is shown coupled to the terminal assembly 225 first and second transistors 228 and 234. The transistor 228 has an emitter electrode coupled to the base of a transistor 233. The transistors 228 and 233 form a parallel T oscillator con-

figuration. The frequency of this oscillator is determined by resistors **219, 220** and **221** and capacitor **222.** Transistor **235** is arranged in a crystal oscillator configuration employing feedback from collector to base through the crystal **224.** This oscillator configuration is sometimes referred to as a Pierce oscillator. The frequency of the parallel T oscillator is in part determined by the components, resistor **221** and capacitor **222;** however, the additional components such as **241** to **246,** which is a T circuit configuration, appear on the master coding card **240.** In this manner, the exact frequency of the oscillator is determined in part by the key card and in part by the master coding card. Both the frequency of the parallel T oscillator and the crystal oscillator are applied via terminals **246** and **247** associated with the master coding card receptacle **239** to operational amplifier circuits **252** and **253** arranged as active bandpass filters. The exact format and structure as well as circuit design of such bandpass filters using operational amplifiers are well known in the art. The active bandpass filters circuits are responsive to the frequency of the parallel T oscillator and the crystal oscillator, the components which determine the most sensitive response of the active bandpass filters are also located on the master coding card **240.** These components include resistors **254, 255** and capitor **256** and **257** for the parallel T oscillator in regard to the active bandpass amplifier **253.** The active bandpass response for the crystal oscillator is also determined by components on the master coding card **240** including resistors **258, 259** and capacitor **261.** It is noted that the insertion of the various cards into the associated receptacles assures proper circuit configuration to enable efficient oscillator and bandpass filter operations. The outputs of the bandpass filters **252** and **253** are modified by means of the voltage dividers and potentiometers. These outputs are coupled to the appropriate inputs of an AND gate **266.** The AND gate provides a positive output when the frequencies are correct which output triggers SCR **272** and activates the coil **270** associated with an electric latch. This therefore enables one to gain access to the secured area.

While the specification has been illustrated in terms of passive key card, it is obvious that key cards could include active devices as transistors and so on to accomplish the results contained herein. It is also noted that the concept described can provide a number of different combinations for any lock having the structure depicted herein and that each and every combination can be correlated between a matching key card and master coding card which cards can be changed quickly and inexpensively at the whim of an operator. Since various modifications will become obvious to those skilled in the art, such modifications are determined to be within the actual scope and breadth of this invention as further defined in the following claims.

We claim:

1. An electronic lock and key system for activating an electric latch to an opened position to permit entry to a secured area, comprising:

a. key means having located thereon at least one electrical component,

b. first means for receiving said key means,

c. second means coupled to said first means and responsive to said key means being received for generating a plurality of reference potential levels, one of said levels selected for energizing said component,

d. means coupled to said first means and responsive to said energized component for providing a control signal different from any of said reference potential levels and solely according to the energization of said component, and

e. comparison means coupled to said latch and responsive to a different one of said potential levels and said control signal to activate said latch when said level and said control signal are within a predetermined range.

2. The electronic lock and key system according to claim **1** further comprising:

a. auxiliary circuit means capable of being selectively received by said first means, said auxiliary circuit means including a separate potential source of a magnitude selected according to said one potential level for causing said means coupled to said first means to generate said control signal for activating said latch independent of said key means.

3. Apparatus for activating an electric latch to an opened position to permit entry to a secured area, comprising:

a. a key receiving receptacle,

b. a key card having located thereon an electrical network, said key card adapted for insertion into said received receptacle,

c. a master coding card coupled to said receptacle and having at least one network located thereon, said network arranged according to said electrical network on said card, to provide a predetermined control signal when a desired key card is being received by said receptacle,

d. a selectively activated source of operating potential capable of providing a plurality of reference potentials when activated,

e. means coupled to said selectively activated source and responsive to the insertion of said key card into said receptacle for activating said source,

f. circuit means coupled to said key card and said master coding card for applying said reference potentials thereto to energize the same to cause said electrical network on said card to modify one of said reference potentials, said modified potential being further modified by said master coding card to provide said control signal, and

g. actuator means coupled to said latch and responsive to said control signal when provided for activating the same to said opened position.

4. The apparatus according to claim **3** further comprising:

a. auxiliary circuit means capable of being selectively coupled to said key receiving receptacle, said auxiliary circuit means including a second source of operating potential of a magnitude selected acording to one of said reference potentials to cause said actuator means to operate independent of said key card.

5. The apparatus according to claim **4** wherein said key card has located thereon a plurality of frequency determining components, each capable of specifying a unique frequency.

6. The apparatus according to claim **5** wherein said master coding card includes a plurality of second frequency determining elements each one of which is associated with only one of said frequency determining

components on said key card to provide a plurality of specific frequency control signals when said desired key card is being received by said receptacle, and means responsive to said frequencies for generating a single control signal manifesting that said desired key card is being received.

7. A locking system of the type for providing an actuation signal operative to energize an electrical latch to permit access to a secured area, comprising:

a. a key card having a plurality of terminals areas on an edge thereof, said card further containing electrical components of a given value and arranged in a given format on said card,

b. a master coding card having a number of terminals associated therewith and having located thereon at least one electrical component selected in accordance with said given value and format of said component on said key card,

c. terminal receptacle means for selectively receiving said key card, said terminal means including receptacle means for receiving said master coding card,

d. reference means coupled to said terminal receptacle means for providing a plurality of reference potentials for applying to said key card at least a first one of said potentials to cause said electrical components on said key card to modify said potential, said modified potential being applied to said master coding card and said electrical component for further modification of said potential to provide a control potential,

e. a comparator having a first and second input terminals and an output terminal, said first input terminal coupled to said master coding card and adapted to receive said control potential, said second input terminal coupled to said reference means for receiving another of said reference potentials to cause an activation signal to appear at said output when said control potential is substantially equal to said another reference potential, and

f. activation means having an input terminal coupled to said output of said comparator and an output terminal coupled to said latch for operating the same upon receipt of said activation signal to permit access to said secured area.

8. The system according to claim **7** further comprising:

a. auxiliary circuit means capable of being selectively coupled to said terminal receptacle means, said auxiliary circuit means including a separate source of potential of a predetermined magnitude to energize said key card and said master coding card to cause said activation means to operate even though there is no correlation of information on said master coding card.

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