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Baskerville et al.

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[54] **CONTROL AND RESPONSE SYSTEMS AND UNITS**

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[73] Assignee: **Folger Adams Co.**, Joliet, Ill.

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[21] Appl. No.: **328,868**

Related U.S. Application Data

[63] Continuation-in-part of Ser. No. 168,951, Aug. 4, 1971, abandoned.

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

[51] **Int. Cl.** **H04q 3/02**

[58] **Field of Search** ..... 340/147 R, 147 MD, 340/166 R, 149 R; 317/134

[56] **References Cited**

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Primary Examiner—Donald J. Yusko
Attorney—James A. Davis et al.

[57] **ABSTRACT**

A coded signal system particularly useful for operating locks in a security institution comprising a portable signaling unit capable of activating a number of response units at various lock locations. The signaling unit comprises a matrix of lights in spatial arrangement which are electrically energized by corresponding selectively operable switches according to a different predetermined coded combination for each response unit. Each response unit comprises a matrix of photoconductive cells in spatial arrangement corresponding to that of the lights of the signaling unit and operatively conductive in response to illumination therefrom, the photoconductive cells being arranged in circuits to operate the lock only when all of a predetermined coded combination of photoconductive cells are illuminated, and to prevent activation of the lock whenever any other photoconductive cells are illuminated, thereby preventing unauthorized operation of the lock by use of an external light such as a flashlight.

5 Claims, 4 Drawing Figures

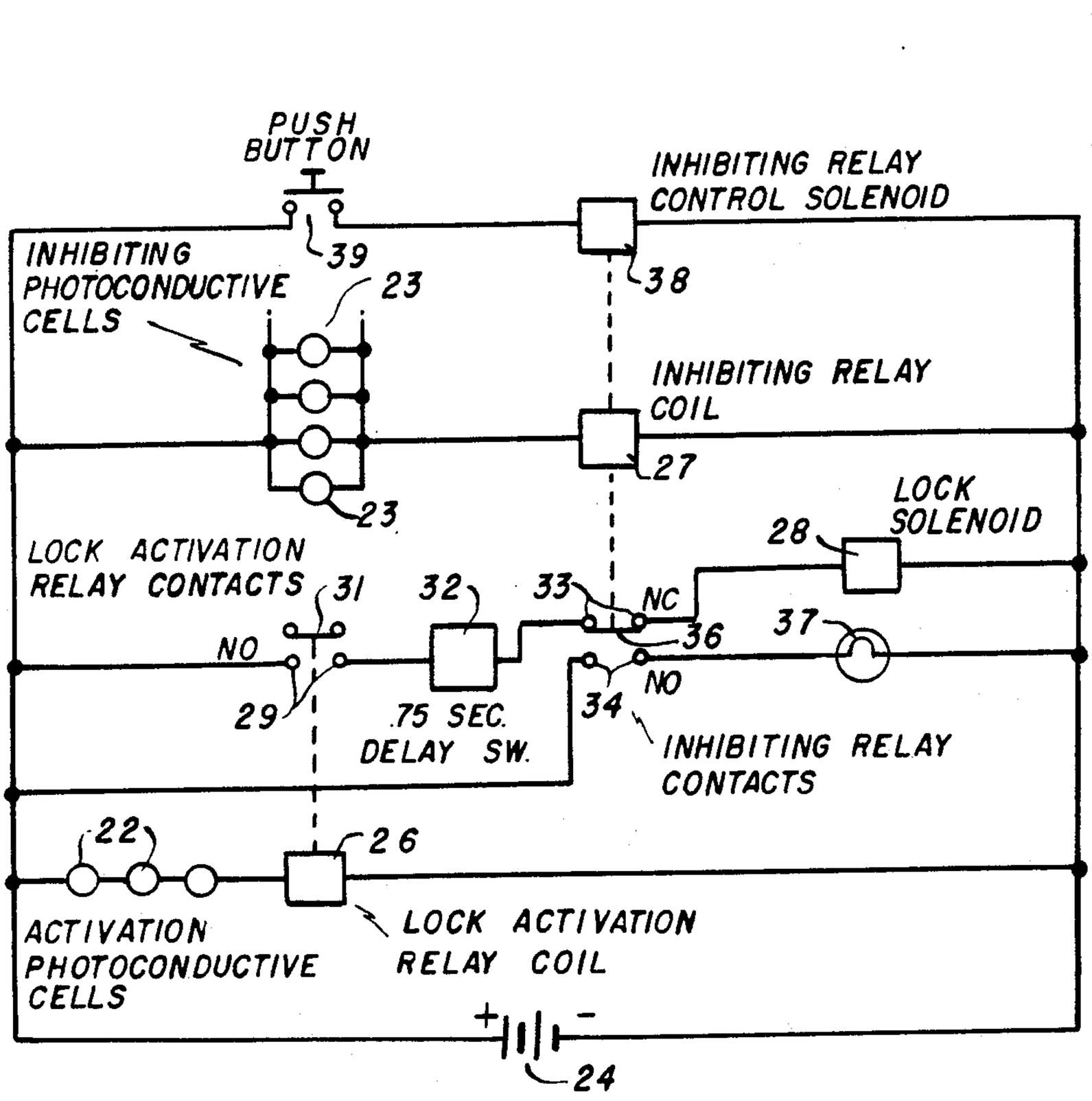


FIG. 2

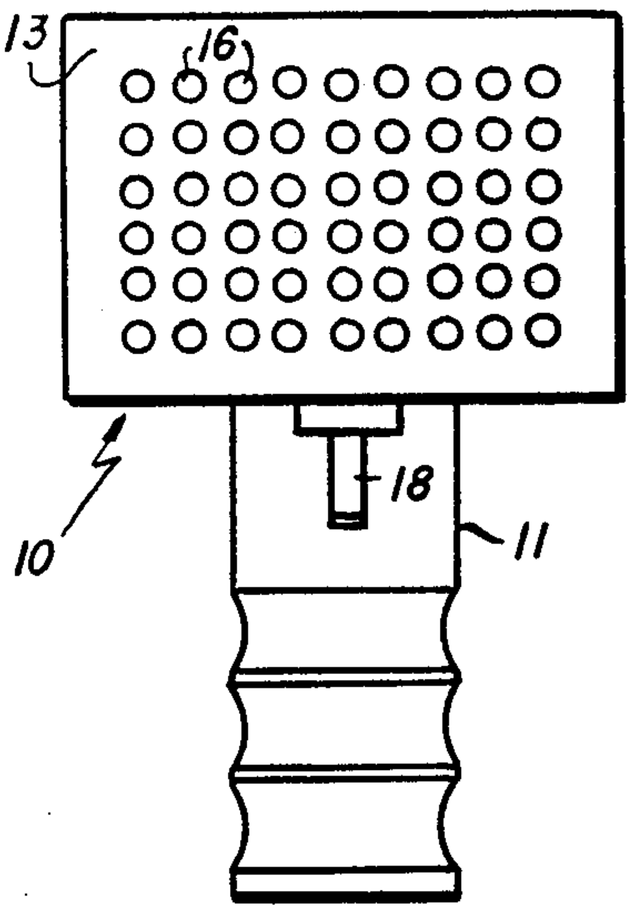


FIG. 1

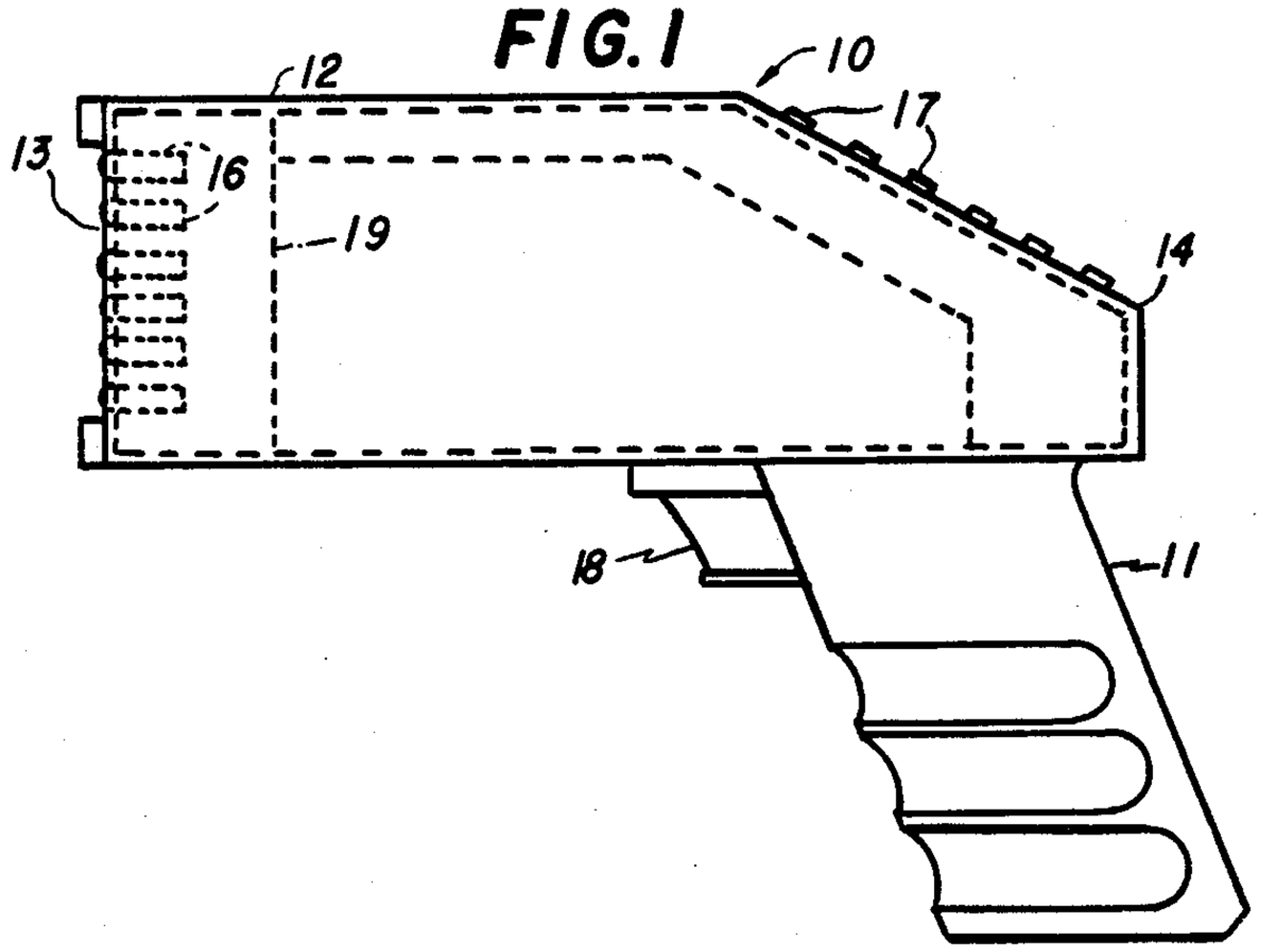


FIG. 3

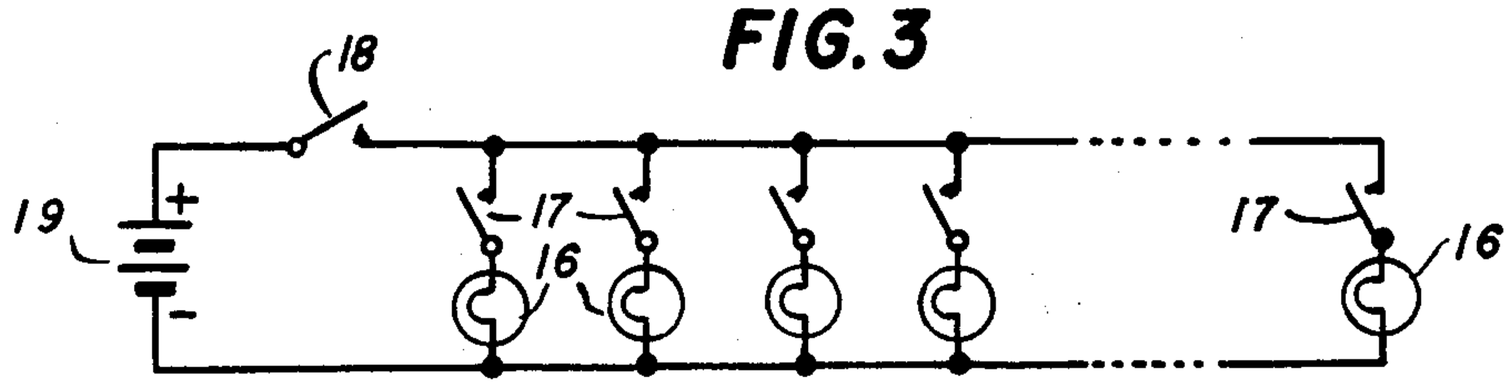
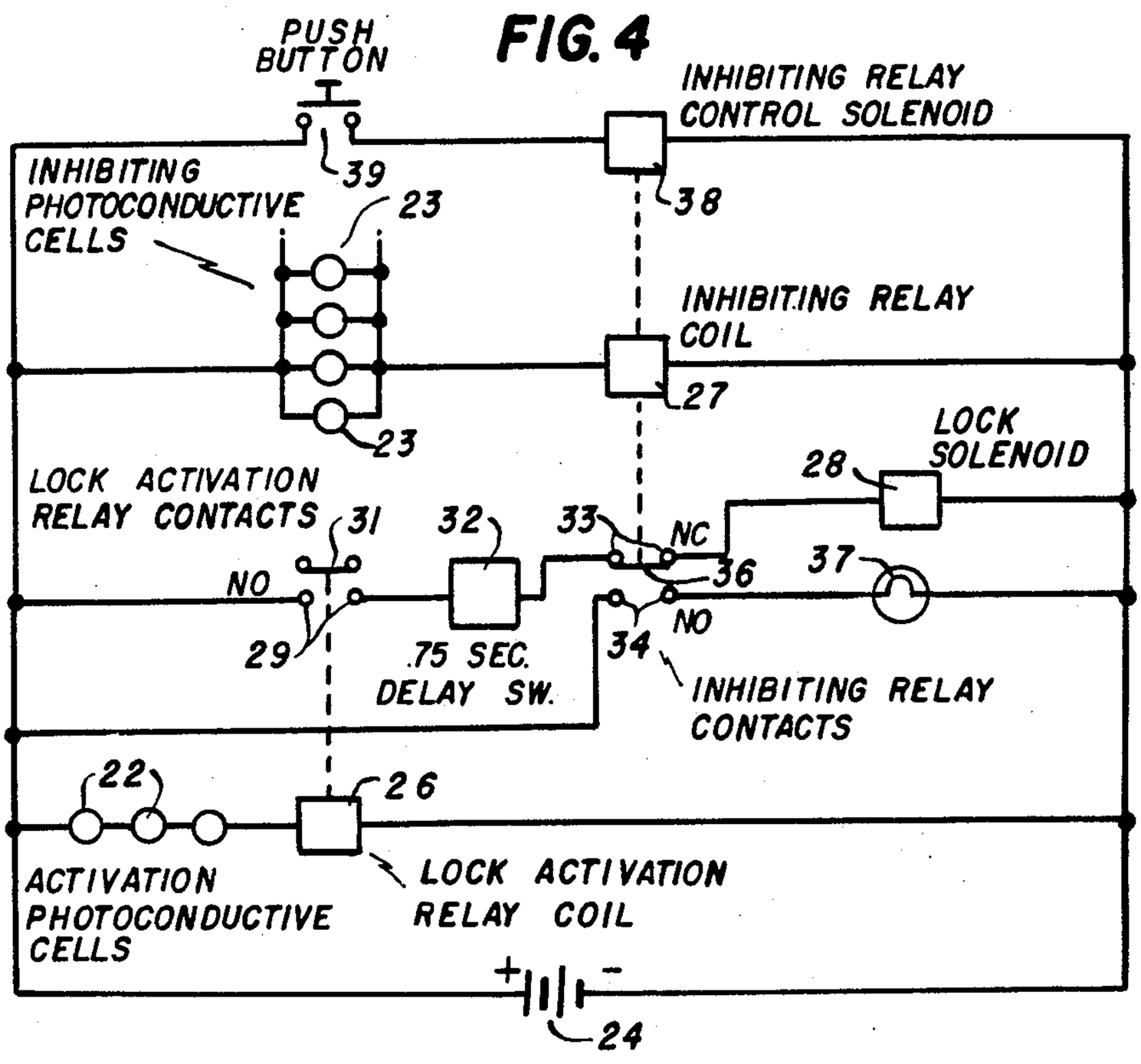


FIG. 4



CONTROL AND RESPONSE SYSTEMS AND UNITS

CROSS-REFERENCE

This application is a continuation-in-part of an application entitled "CONTROL AND RESPONSE SYSTEMS AND UNITS" by James E. Baskerville and Charles T. Creekman, Jr., filed on Aug. 4, 1971 and having Ser. No. 168,951, now abandoned.

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates generally to control and response systems and units, and more particularly to electronic security systems useful for operating locks in a security institution which prevent unauthorized operation of locks.

2. Description of the Prior Art

Electronic security systems have been provided which employ the use of cards containing coding information for operating a photoelectric locking system. The system disclosed in U. S. Pat. No. 3,239,815 employs a dual card system comprising both a master code card and mating key card simulating the master card to operate a locking system. However, the need has arisen for a coded signal system especially suitable for operating locks in a security institution which prevents unauthorized operation of locks resulting from the theft or loss of cards containing coding information.

SUMMARY OF THE INVENTION

This invention employs a portable signaling unit, capable of activating a number of response units, which comprises a matrix of lights in spatial arrangement which are energized by corresponding selectively operable switches according to a different predetermined coded combination for each lock. The response units at various lock locations each comprise a matrix of photoconductive cells in spatial arrangement corresponding to that of the lights of the signaling unit and operatively conductive in response to illumination therefrom, the photoconductive cells being arranged in circuits to operate the lock only when all of the predetermined coded combination of cells are illuminated, and to prevent activation of the lock if any other photoconductive cells are illuminated. The coding information required to operate the system of the present invention is provided by selective operation of the switches located on the signaling unit. The different predetermined coded combination of switch operations required to activate each lock is memorized by an authorized lock operator. Since operation of any switch other than that comprising the predetermined coded combination will operate to prevent activation of the lock, theft or loss of the signaling units will not result in unauthorized lock operation. Furthermore, if unauthorized operation of any lock is unsuccessfully attemped, the lock is rendered deactivated until the system is reset from a remote location.

In the drawings:

FIG. **1** is a side elevation of a hand-held portable signaling unit embodying the present invention;

FIG. **2** is a front elevation view of the signaling unit illustrated in FIG. **1**;

FIG. **3** is a simplified electrical schematic diagram of the signaling unit illustrated in FIGS. **1** and **2**; and

FIG. **4** is an electrical schematic diagram of one of the response units operated by the signaling unit.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring to FIGS. **1** and **2**, the signaling unit, illustrated generally at **10**, comprises a hand-held portable device comprising a handle **11** and a body **12** having a front face **13** and a rear face **14**. A matrix of light generating means or lights **16** is mounted in spatial arrangement partially inside the front face **13** such that the illumination of each of said lights is operatively directed forward from the signaling unit **10**. A corresponding matrix of selectively operable switches **17** is provided on the rear face **14**, each of said switches **17** corresponding to a particular one of said lights **16**, for simultaneously energizing a preselected coded combination of lights **16**, in conjunction with a master switch **18**, from a battery **19** mounted within the body **12**, the circuit being illustrated in FIG. **3**. An operator first sets or closes the memorized preselected combination of switches **17** corresponding to the lights **16** which are desired to be illuminated and then energizes said combination of lights **16** upon closing master switch **18**, which is preferably of the momentary contact type. It should be noted that, because of the large number of lights **16** and corresponding switches **17**, there are many possible combinations of lights **16** that can be illuminated.

In the preferred embodiment of the present invention, the response units are fixedly mounted at various lock locations and are operable by a portable signaling unit **10** to activate a lock. Although the physical form of a typical response unit is not illustrated in the drawings, the electrical schematic of FIG. **4** illustrates its principal features. A response unit, illustrated generally at **21**, comprises a matrix of light responsive conducting means or photoconductive cells, partially illustrated in that figure for purpose of simplification. The photoconductive cells of the response units comprise two groups: the activation photoconductive cells **22** connected in series circuit arrangement, and the inhibiting photoconductive cells **23** connected in parallel circuit arrangement. Both groups comprise the matrix of photoconductive cells which are mounted in spatial arrangement corresponding to the spatial arrangement of the lights **16** of the signaling unit **10**. In operating the signal system, the signaling unit **10** is held next to a response unit such that the matrix of lights **16** is located directly opposite and adjacent to the matrix of photoconductive cells of the response unit **21**, whereby each photoconductive cell is operatively conductive in response to illumination from a corresponding light **16**.

The matrix of photoconductive cells comprises a combination of activation photoconductive cells **22**, with the remaining photoconductive cells comprising the group of inhibiting photoconductive cells **23**. The response unit **21** comprises a sealed box or case containing the electrical connection such that it is impossible to determine which photoconductive cells of the matrix comprise the group of activation photoconductive cells **22** by visual inspection of its exterior. Furthermore, the external case of the response unit **21** is preferably constructed of a strong material in order to prevent tampering with the electrical connections contained therein.

As shown in FIG. **4**, the response unit **21** comprises a source of electrical energy **24**, preferably an externally supplied DC source interconnected with an emer-

gency portable rechargeable battery, in parallel circuit arrangement with the group of activation photoconductive cells **22** and the group of inhibiting photoconductive cells **23**, only a few of the photoconductive cells of each said group being illustrated in FIG. **4**. The group of activation photoconductive cells **22**, interconnected in series, comprises a plurality of photoconductive cells spatially distributed in the matrix of photoconductive cells according to a predetermined coded arrangement which may vary with each of the response units **21**. The remaining photoconductive cells of the matrix comprises the group of inhibiting photoconductive **23**, which are interconnected in parallel. A lock activation relay coil **26** of a lock activation relay is connected in series with the group of activation photoconductive cells **22** and is operatively energized from the DC source **24** in response to simultaneous conduction of all of the activation photoconductive cells **22**. An inhibiting relay coil **27** of an inhibiting relay is similarly connected in series with the group of inhibiting photoconductive cells **23**, but is operatively energized from the DC source **24** in response to conduction of any of the inhibiting photoconductive cells **23**. The lock activation relay coil **26** operates to energize a lock solenoid **28** from the DC source **24**, which results in the opening of the desired lock (not illustrated). The inhibiting relay coil **27**, however, operates to isolate the lock solenoid **28** from the DC source **24** even when the lock activation relay coil **26** is also energized. It is important to note that the response unit **21** will operate a lock only when all of the activation photoconductive cells **22** are illuminated by corresponding lights **16** of the signaling unit **10** and none of the inhibiting photoconductive cells **23** are also illuminated, in order to prevent unauthorized operation of the lock.

The lock activation relay coil **26** operates to close normally open relay contacts **29** of the lock activation relay by moving movable relay contact **31** into engagement therewith in order to energize the lock solenoid **28** from the DC source **24** through a time delay switch **32** and normally closed relay contacts **33** of the inhibiting relay. The time delay switch, operating to delay completion of the lock solenoid circuit by a period of time, preferably on the order of 0.75 seconds, prevents energization of the lock solenoid **28** until the inhibiting relay coil **27** has sufficient time to open the normally closed relay contact **33** and to close normally open relay contacts **34** by means of a movable relay contact **36**, if the inhibiting relay coil operates at all. When the inhibiting relay coil **27** operates, an alarm light **37**, preferably remotely located from the response unit **21**, is energized from the DC source **24** when the normally open relay contacts **34** are closed by the movable relay contact **36**.

The inhibiting relay is further provided with conventional latching means to prevent restoration of the inhibiting relay contacts to their normal positions until released and reset by an inhibiting relay control solenoid **38**, which is energized from the DC source **24** through a pushbutton switch **39**, preferably remotely located from the response unit **21**. Once unauthorized operation of the response unit is unsuccessfully attemped, the inhibiting relay coil operates to first isolate the lock solenoid **28** from the DC source **24**, then to energize a remotely located alarm light **37** and to prevent further response unit operation until response unit **21** is reset from a remote location. Thus, theft or loss of the signaling unit **10** will not permit unauthorized operation of a lock controlled by a response unit **21** unless the operator correctly selects and sets only those switches **17** of the predetermined coded combination, which is most unlikely to occur because of the numerous possible arrangements of activation photoconductive cells **22** and the deactivation effect of the inhibiting photoconductive cells **23**. It will be appreciated that a larger or smaller number of the photoconductive cells may be used as activation cells **22** than the three in the illustrated embodiment, even one cell **22** being effective, and that the larger the number of cells employed as inhibiting cells **23**, the greater are the chances that an unauthorized attempt to energize the lock solenoid **28** will be prevented. It also is apparent that response unit **21** cannot be unauthorizedly operated by light from an external source, such as a flashlight, since such attempted operation invariably will illuminate at least one of the inhibiting photoconductive cells **23**.

The light generating means or lights **16** of the signaling unit **10** could be selected to emit light at different frequencies according to a predetermined code, with corresponding activation photoconductive cells **22** responsive only to illumination at those particular frequencies by means of light filters, for example, in order to render the system of the present invention even more secure from tampering.

It is thought that the invention and many of its attendant advantages will be understood from the foregoing description, and it will be apparent that various changes may be made in the form, construction and arrangement of the parts without departing from the spirit and scope of the invention or sacrificing all of its material advantages, the form hereinbefore described being merely a preferred embodiment thereof.

We claim:

1. A coded signal system comprising:

signaling means having a plurality of selectively operable switches, a source of electrical energy and a plurality of light generating means in spatial arrangement, all in a circuit for simultaneously activating selected ones of said plurality of light generating means by energization from said source; response means having a first plurality of light responsive conducting means in series circuit arrangement, a second plurality of light responsive conducting means in parallel circuit arrangement, each of said light responsive conducting means being spatially located opposite a corresponding one of said light generating means and operatively conductive in response to illumination therefrom when said signaling means is operatively positioned relative to said response means; a source of electrical energy, and an activation relay in circuit with said first plurality and said source and operable to connect said source to a desired load in response to illumination of all of said first plurality of light responsive conducting means, and an inhibiting relay in circuit with said second plurality and said source and operable to isolate said source from said load in response to illumination of any of said second plurality of light responsive conducting means; whereby said load is energized only in response to simultaneous operation of a predetermined coded combination of said switches for energizing light generating means corresponding to said first plurality of light responsive conducting

means, and is isolated from said source in response to operaof any other of said switches to prevent unauthorized energization of said load.

2. The invention according to claim 1, wherein each said light responsive conducting means comprises a photoconductive cell.

3. The invention according to claim 1, wherein said signaling means comprises a hand-held portable unit capable of actuating a plurality of said response means at various fixed locations.

4. The invention according to claim 1, wherein said inhibiting relay comprises latching means and a control solenoid therefor, whereby said latching means maintains said load isolated from said source until said latching means is released by said control solenoid.

5. The invention according to claim 1, wherein each said light generating means is operable to emit light at a different frequency according to a predetermined code, and each light responsive conducting means of said first plurality is operatively conductive in response to illumination from a corresponding one of said light generating means only at a particular frequency.

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