

[54] **LIGHT PULSE BURGLAR ALARM**
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[51] Int. Cl. **G08b 13/08**, G08b 1/00
[58] Field of Search 340/258 B, 258 D, 416, 224,
340/274, 188, 189, 190; 250/214 P, 199

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[57] **ABSTRACT**

A light pulsating burglar alarm system and method is provided employing a plurality of separated photoflash units that are individually and selectively triggered upon the opening of a door, window, or other opening to produce a high intensity light pulse of predetermined optical characteristics.

A centralized detector selectively responds to the light pulse produced by anyone of these triggered units to annunciate the presence of the intruder. Alternatively, one or more light pulse producing relays may be employed to respond to the pulse and produce a secondary light pulse for further transmission to remote locations out of optical communication with the nuts.

14 Claims, 5 Drawing Figures

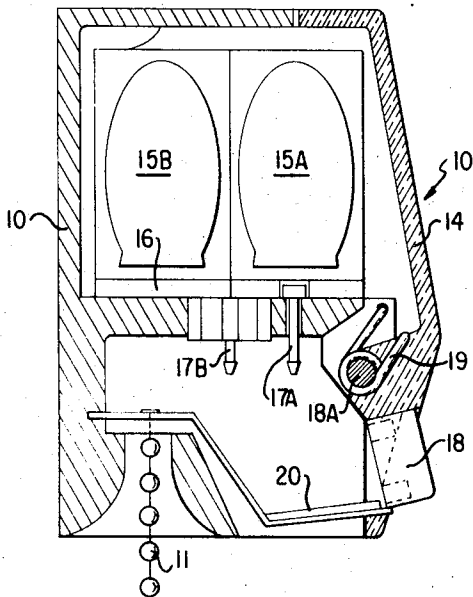


FIG. 1

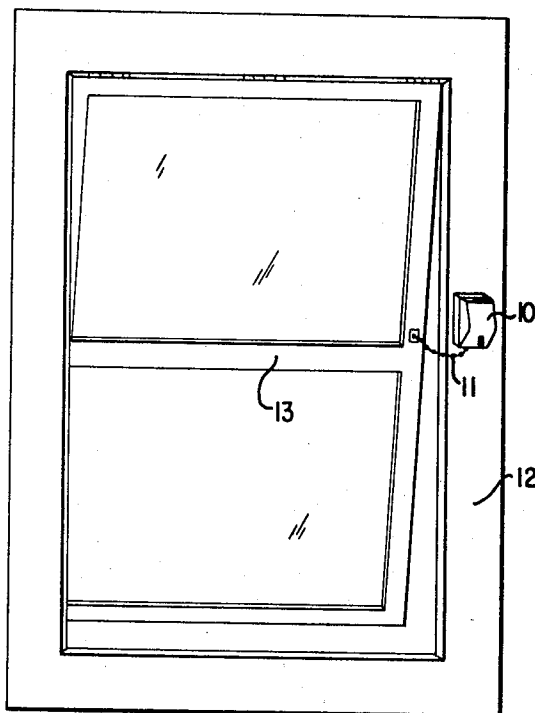
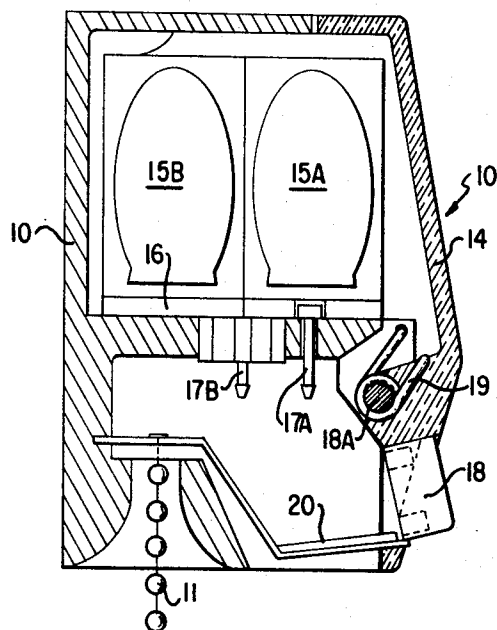


FIG. 2



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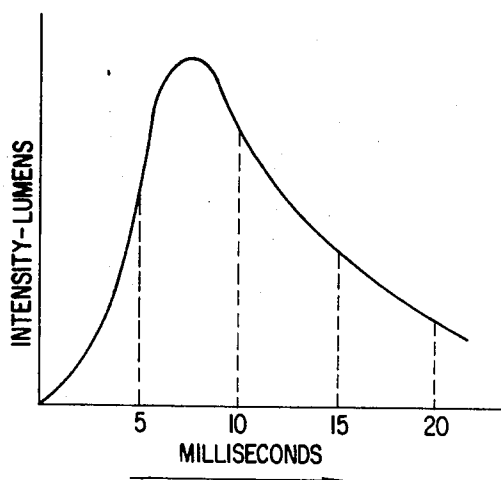


FIG. 3

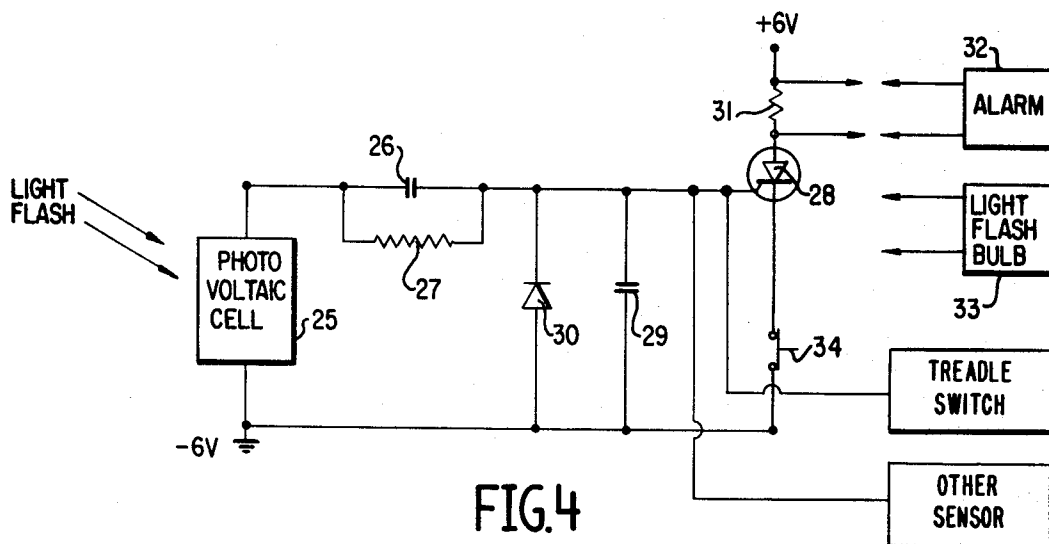


FIG. 4

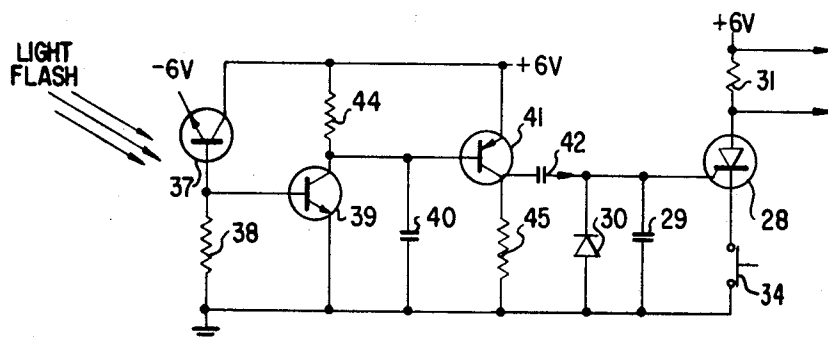


FIG. 5

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LIGHT PULSE BURGLAR ALARM**STATEMENT OF THE INVENTION**

This invention relates to burglar alarms, and is particularly concerned with alarms that are useful for inexpensively guarding the interior of buildings against unauthorized intrusion through doors or windows but that may be employed extensively elsewhere.

BACKGROUND AND PRIOR ART

The most commonly used burglar alarm system for detecting unauthorized entry into buildings is the electrically wired type wherein all doors, windows, and other entrances and exits are electrically wired together in one or more common circuits in such manner that the electrical circuit is broken, (or completed), upon authorized entry to energize an annunciator or an alarm signaling device. Such systems have obtained a rather high degree of sophistication, often incorporating fail-safe or anti-defeat circuitry that functions despite power failure or that prevents skilled burglars from neutralizing the effectiveness of the system. However, since journeyman electricians are required to install and service these systems, and since local building codes often impose expensive restrictions on wiring buildings the costs of installation and maintenance of such wired systems are considerable, and in some instances disproportionately costly where an older building such as warehouse, is to be rewired according to modern codes.

To reduce the high costs of such wired systems, various types of unwired systems using radiant beam communication instead of wiring have been used; including those that employ battery powered radio transmitters at each of the doors or windows. However, known radiant beam systems of this type are also comparatively expensive since a separate battery powered radiowave or sonic transmitter is usually required for each window and door. Furthermore, these systems are relatively unreliable due to battery failure and therefore require frequent inspection, testing, and servicing. A still further disadvantage of these radiant wave systems is that the alarms may be often inadvertently triggered by spurious noises or spurious radio signals since the more highly selective the system, the greater is its cost and complexity.

SUMMARY OF THE INVENTION AND ADVANTAGES

According to the present invention there is provided an unwired radiant beam system and method using light pulses that is substantially more reliable than other radiant beam systems yet considerably less expensive. In a preferred embodiment, each of the transmitters employs a disposable and inexpensive contact-actuated pyrotechnic photoflash unit that is self-energizable and does not require an electrical battery or other power source. When triggered by the unauthorized opening of a window or door, the unit generates a very high intensity light pulse of predetermined transient light characteristics that is propagated outwardly for substantial distances.

At a centralized location in optical communication with a series of such transmitters, is provided a detector photocell and electronic discriminator circuit that

selectively responds to the characteristics of the transient, high intensity light pulses yet is relatively insensitive to other ambient light conditions. Depending upon the geometric configuration of the area to be protected, one or more of such receivers may be employed.

For completely eliminating any electrical wiring between plural detectors in a multi-room building or for transmitting the detected signal to a further remote location without wiring, the detector may alternatively be in the form of a light relaying unit that responds to a light pulse from any one of the transmitters to itself produce a secondary light pulse from a disposable photoflash unit provided as part of the light relay. By using a series of separated light relays of this type, a concatenated series of such secondary light pulses may be generated in rapid sequence at spaced locations to communicate a warning signal from place-to-place in a chain type reaction, thereby providing substantially complete burglar alarm detection of the most complex multi-room buildings.

DESCRIPTION OF THE DRAWINGS

FIG. 1 is a schematic illustration of a light pulse transmitter unit interconnected to a window,

FIG. 2 is an enlarged sectional view illustrating details of a preferred transmitter unit,

FIG. 3 is plotted graph illustrating the transient characteristics of the optical pulse, and

FIG. 4 and 5 are schematic electrical diagrams showing preferred light pulse detectors and alarm or light relay circuits.

DESCRIPTION OF A PREFERRED EMBODIMENT

As illustrated in FIGS. 1 and 2, the photo flash transmitter 10 is preferably a small, inexpensive, disposable unit that may be easily attached to a window frame 12 or door frame and easily connected by a short chain or cable 11 to the openable window 13, door or other access opening member. Any number of such units may be employed in a room or building since each unit is completely independent in operation from the others.

A preferred transmitter unit 10 as shown in FIG. 2 employs a hollow molded plastic housing having a forward looking wall 14 and containing one or more single use, disposable photoflash bulbs 15 supported inside. The bulbs 15 are arranged to be triggered by tension applied to a chain 11 leading from the unit, to transmit a high intensity light pulse radiated outwardly through the window over a wide angle.

According to the invention, it is desired to employ highly reliable, inexpensive, and self-powered photoflash units having a relatively long shelf life. A multiple light flash element of this type is presently sold by Sylvania Electric under the name MAGICUBE, having an advertised reliability of operation of 99.7 percent. This multiple unit includes four miniature flash lamps 15A, 15B, etc., interconnected in a box like configuration supported on a base 16. Each different flash unit is individually triggerable by displacing a separate driving pin such as 17A. These units 15 emit light by combustion of zirconium inside of each bulb, and this combustion is initiated by a pyrotechnic impact ignitor incorporated within the unit for each bulb and actuated by minor displacement of the pin, such as 17A. No

separate electrical battery or other source of power is required. Each such flash element produces an illumination of approximately 2,000 beam candle power seconds, with most of the energy being generated in a transient peaked pulse, of about 10 milliseconds in time duration, as shown by the waveform in FIG. 3.

In the preferred transmitter unit of FIG. 2, a pair of such flash bulb elements 15A and 15B are triggered simultaneously when the chain 11 is pulled down. This operation is as follows:

Inside of the housing 10 is provided a lever 18 rotatable about pivot 18A, and normally urged by a compressed spring 19 to rotate in a clockwise direction and strike the pair of pins 17A and 17B. The right hand end of a flat spring 20 disposed at the base of unit 10 serves as a stop to maintain the lever 18 in its vertical position as shown and out of contact with the pins 17A and 17B. The left hand end of this flat spring 20 is fastened inside the housing, as shown, at a position close to the connection of this spring 20 with pull down chain 11. When the chain 11 is pulled, the flat spring 20 is displaced downwardly (pivoted slightly about its left hand end) and its right hand end portion is removed as a stop against lever 18, whereupon lever 18 is released and pivoted upwardly by compressed spring 19 to strike the pins 17A and 17B and thereby ignite both of flash units 15A and 15B together. The combined light pulse from both bulbs is radiated through the opening in the unit 10 at a very high intensity and in the time-intensity waveform pulse shown in FIG. 3.

In optical communication with a series of such transmitter units that may be spaced apart on various doors and windows, is provided a centralized light pulse receiver and alarm circuit and or a light relay circuit. This receiver responds to the generation of the particular transient light pulses from any one of the photoflash transmitters to produce an audible or visible alarm signal that warns of an unauthorized violation of the integrity of the guarded premises. However, since the preferred burglar systems may be employed at locations having ambient lighting conditions, such as sunlight through a window; and even under changes in ambient lighting, such as the turning "on" and "off" of interior lights in a building, it is required that this receiver be insensitive to such ambient conditions yet reliably respond to light pulsing from any one of the triggered transmitters. This is performed by employing discriminating circuitry in the receiver unit that is sensitized to respond only to light having the particular characteristics of the photoflash waveform.

FIG. 3 illustrates details of one preferred detector discriminator circuit that has been found capable of responding to the transient light pulse being produced by such a transmitter from as far away as fifty feet from the receiver, yet being insensitive to the ambient light pulses produced by turning "on" or "off" of overhead room lighting in a closed room. As shown, the receiver employs a photovoltaic cell 25 producing a voltage in proportion to the intensity of received light. The discriminator circuit includes a parallel arranged capacitor 26 and resistor 27 interconnecting this cell 25 with a silicon controlled rectifier 28 and related switching circuit. The time constant of this parallel R-C circuit 26 and 27 is made very short so that this circuit provides a very high impedance in response to slowly changing

signals as might result from the slow application of strong sunlight to the light cell 25.

Accordingly, in response to slow changes in ambient lighting a very small portion of the voltage of cell 25 appears across storage capacitor 29 even when the cell 25 is exposed to direct sunlight. On the other hand, for a high frequency transient light pulse of short enough duration, as might occur upon the turning "on" or "off" of ambient interior lighting, the reactance of capacitor 26 is small enough to pass the pulse. However, the instantaneous intensity of such a pulse produced by ambient lighting is so far less than that of the photoflash pulse for which the circuit is designed, that insufficient voltage is applied to the gate of the SCR 28 to trigger the SCR into conduction. The combination of very high intensity light from a photoflash transmitter coupled with its short time duration, does apply sufficient voltage across capacitor 29 to trigger the SCR 28 into conduction, thereby passing current through the load resistor 31. An audible or visible alarm 32 connected across the load resistor 31 is thereupon continuously energized by the triggered SCR 28 to warn of an unauthorized intrusion. Such alarm 32 may be in the form of a horn, bell, telephone dialer, or any other electrically operated alarm as might be desired for the particular application.

When the premises to be protected are comprised of a series of separated rooms or other partitioned areas, a receiver of this type may be employed in each such room. Alternatively, a series of light producing relays may be employed instead to optically interconnect all of the rooms together in a concatenated light chain using a single centralized alarm device or warning system. To provide such a light relay, an electrically triggered photoflash bulb and socket 33 may be placed across the load resistor 31 instead of (or in addition to) alarm device 32. In operation, the detection of an intruder entering any of the rooms triggers a transmitter to produce a light flash, as before, which pulse is detected by the light relay unit nearby that is located in that room. Current flow through resistor 31 energizes bulb 33 to then generate a sympathetic flash of light upon detecting the transmitter light flash. The light relay unit is so located as to transmit its sympathetic light pulse out of the room or area into the next room or area which either an detector-alarm may be located or another light relay unit. By properly placing a series of such light relays, all partitioned interconnecting areas of any building structure may be placed in optical communication with one another to provide a comprehensive, highly reliable, and inexpensive, burglar alarm system without the need for any interconnecting wiring. It will be noted that such light pulse communications may be made between different elevations (floors) of buildings by passing light pulses up and down staircases, or transmitting light pulses through openings in walls and floors, or through light piping extending therethrough.

It will be noted that the light pulsing burglar alarm system as described may also be combined and interconnected with other types of alarm systems, or other types of detectors may be coupled into this system. For example, foot operated treadle switch sensors may be connected to also energize the detector-alarm circuits or the light relay circuits. Since such sensor devices

operate by closing electrical switches, these switches may be easily connected in the circuit of FIG. 4 to trigger the SCR 28 into conduction. In this case, the actuation of either the foot switch or the generation of a transmitter light pulse would selectively trigger the alarm 32, or would selectively trigger the production of a sympathetic light pulse or a concatenated series of such pulses. In a similar manner other detecting devices may be coupled into the system to operate the receivers or light relay units.

FIG. 5 illustrates an alternative receiver circuit employing a phototransistor 37, instead of the photovoltaic cell 25 of FIG. 4. In this circuit, the time constant of a series connected resistor 44 and capacitor 40 responds only to high frequency or short duration pulses corresponding to the characteristics of a photoflash pulse, and the transistors 39 and 41 function as on-off switches. A light pulse of the desired characteristic triggers this circuit, as in FIG. 4, to apply sufficient energization across capacitor 29 to trigger SCR 28 into conduction, thereby to register an alarm or produce a secondary light flash pulse. It will be understood that other receiver circuits may be employed that discriminate against light other than a photoflash pulse.

Both the detector circuits of FIGS. 4 and 5 may be energized by a low voltage battery, or by an ac power source, or by both, on a selective basis whereby should the ac power fail, the dc battery provides energization. Both preferred circuits do not draw current from the source before reception of the photoflash, whereby the battery life is almost equal to the open circuit shelf life. After response to the photoflash, the SCR remains continuously "on", passing current to the alarm until the circuit is manually reset by opening the switch 34.

It will be appreciated that the light flashing units 15A, 15B, and 33 are preferably expendable, single use devices that must be replaced or reset to use the other two bulbs after being triggered. However, since these units are mass produced element having very low cost; and also are units of extremely high reliability with long shelf life, they are preferred according to the present invention for most applications over the use of multiple use, light flashing elements. Furthermore as previously stated, these preferred devices are self-powered and require no batteries or other additional power source which materially adds to reliability of the overall system and reduces the cost of the system.

An additional advantage of the light flashing element mode of operation is that the unauthorized intruder or burglar is startled by the emission of light pulses and may be frightened or otherwise discouraged and accordingly leave the premises. A camera mechanism (not shown) may also be activated by the light pulse to photograph the intruder as well as signaling an alarm of his presence as discussed above.

In some applications, however, it may be desired that the intruder not be made aware of the fact that his unauthorized entry, or triggering of the detector, has been discovered. This may be accomplished according to the invention by employing a wavelength of light, or radiant energy, falling outside of the visible bandwidth, such as in the infra-red or ultraviolet wavelengths. To operate in the infra-red band, an infra-red filter may be employed as a covering over the window 14 of the transmitter unit or alternatively as an integral part of

the window 14. According the radiated energy pulse would be invisible to the intruder or burglar yet detectable by a properly designed receiver using a photodetector sensitive to infra-red wavelengths. A secrecy system of this type may be particularly advantageous for protecting safes and the like against unauthorized entry, wherein the police may be alerted by the received detection of the invisible light pulse yet the burglar would be unaware that his unlawful activities have been discovered and therefore may be apprehended before his escape from the premises.

Many other changes and variations may be made by those skilled in this art and accordingly this invention is to be considered limited only by the following claims:

I claim:

1. A burglar alarm system comprising:
 - a plurality of spaced apart light pulse transmitters, each transmitter coupled to a window, door, and other entry means; and including triggering means for initiating said transmitter to emit a discrete high intensity light pulse of predetermined transient characteristic upon the opening of said entry means,
 - a centralized light pulse detector spaced from and in optical communication with said transmitters, said detector including discriminating means selectively responsive to said predetermined transient characteristic of said light pulse and substantially unresponsive to ambient lighting conditions from other means or changes therein, and means responsive to said detector for producing an alarm signal upon detection of said light pulse.
2. In the alarm system of claim 15, each of said light transmitters including a photoflash unit.
3. In the alarm system of claim 15, said photoflash units being a self powered and contact actuated pyrotechnic unit.
4. In the system of claim 15, said centralized light pulse detector responsive to the generation of a light pulse from any one of said transmitters to produce a secondary light pulse.
5. In the system of claim 4, plural separated detectors, each such detector disposed in a different location in optical communication with at least one other detector.
6. In the system of claim 15, additional sensor means for actuating said detector upon determining the presence of an intruder.
7. In the system of claim 4, additional sensor means for actuating said detector upon determining the presence of an unauthorized intruder.
8. In the system of claim 5, additional sensor means for actuating one of said plural detectors upon determining the presence of an unauthorized intruder.
9. A method of detecting the presence of an intruder entering into a proscribed area comprising the steps of:
 - sensing the presence of said intruder at any one of a plurality of separate peripheral locations circumscribing said area,
 - triggering the generation of a discrete high intensity light pulse of predetermined transient characteristic at said sensed location,
 - and discriminatingly detecting the generation of said light pulse from any one of a plurality of said locations at a centralized position, and producing an

alarm in response to said detection while substantially unresponding to ambient lighting at said centralized location.

10. In the method of claim 11, the step of detecting including the step of triggering the generation of a secondary light pulse at said central location upon detecting said light pulse from said peripheral location, whereby said sympathetic light pulses serves as a relay to communicate the presence of said intruder to places not in optical communication with said peripheral locations.

11. In the method of claim 9, the additional step of otherwise sensing the presence of an intruder and producing an alarm in concert with and in the absence of triggering the generation of light pulses at said peripheral locations.

12. A burglar alarm system comprising:

a light pulse transmitter,
said transmitter coupled to one of a window, door, and other entry means; and including triggering means for initiating said transmitter to emit a dis-

crete high intensity light pulse of predetermined transient characteristic upon the opening of said entry means,

a light pulse detector spaced from and in optical communication with said transmitter,

said detector including discriminating means selectively responsive to said predetermined transient characteristic of said light pulse and substantially unresponsive to ambient lighting conditions from other means or changes therein,

and means responsive to said detector for producing an alarm signal upon detection of said light pulse.

13. In the alarm system of claim 12, said light pulse being in a nonvisible wavelength unobservable to the human eye.

14. In the alarm system of claim 12, a plurality of said transmitters each triggerable by an unauthorized actuation of a different member and said detector in optical communication with said transmitters.

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