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[54] **INTRUSION ALARM ACTUATING APPARATUS**

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[51] **Int. Cl.** **G08b 13/08**

[58] **Field of Search**..... 340/276, 274 C, 271, 223, 340/412, 282, 274 R; 70/432, 434, 277, 278

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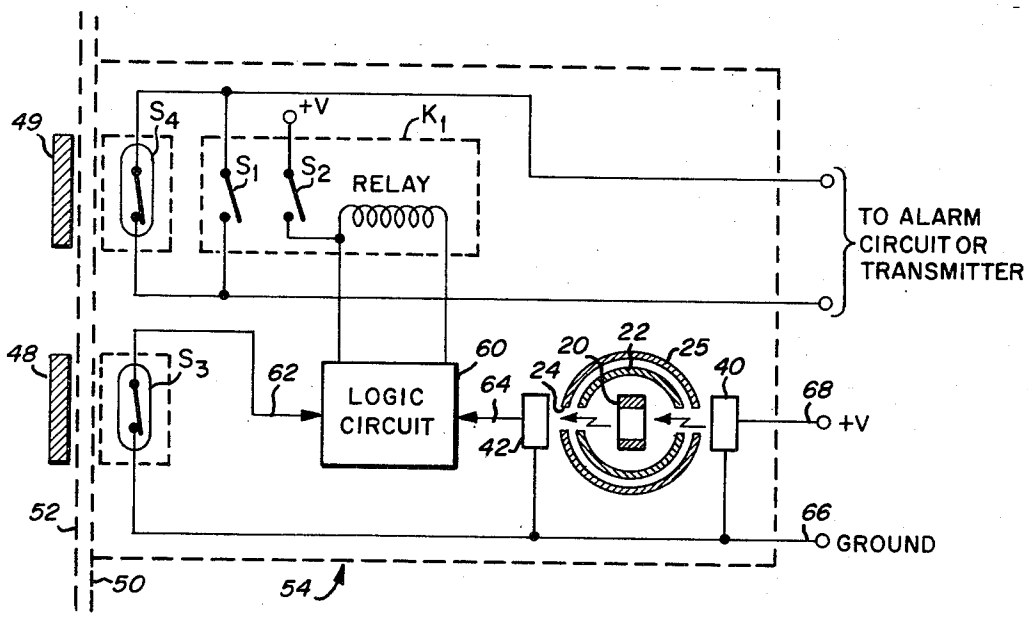
Primary Examiner—John W. Caldwell
Assistant Examiner—Marshall M. Curtis
Attorney, Agent, or Firm—Schatzel & Hamrick

[57] **ABSTRACT**

A sensing apparatus enclosed in a small attractive housing for attachment to standard door locking hardware or the like and including simple magnetic door closure sensing switches, a photosensitive locking mechanism detector and compact electronic logic circuitry combined in such a manner as to simultaneously detect the door closure and condition of the locking mechanism, and then actuate either an external hard-wired alarm circuit or the radio frequency transmitter of a wireless alarm system should the door be opened without first being unlocked in the normal manner. The alarm system is thus in effect armed and disarmed by the normal locking and unlocking of the door.

10 Claims, 3 Drawing Figures



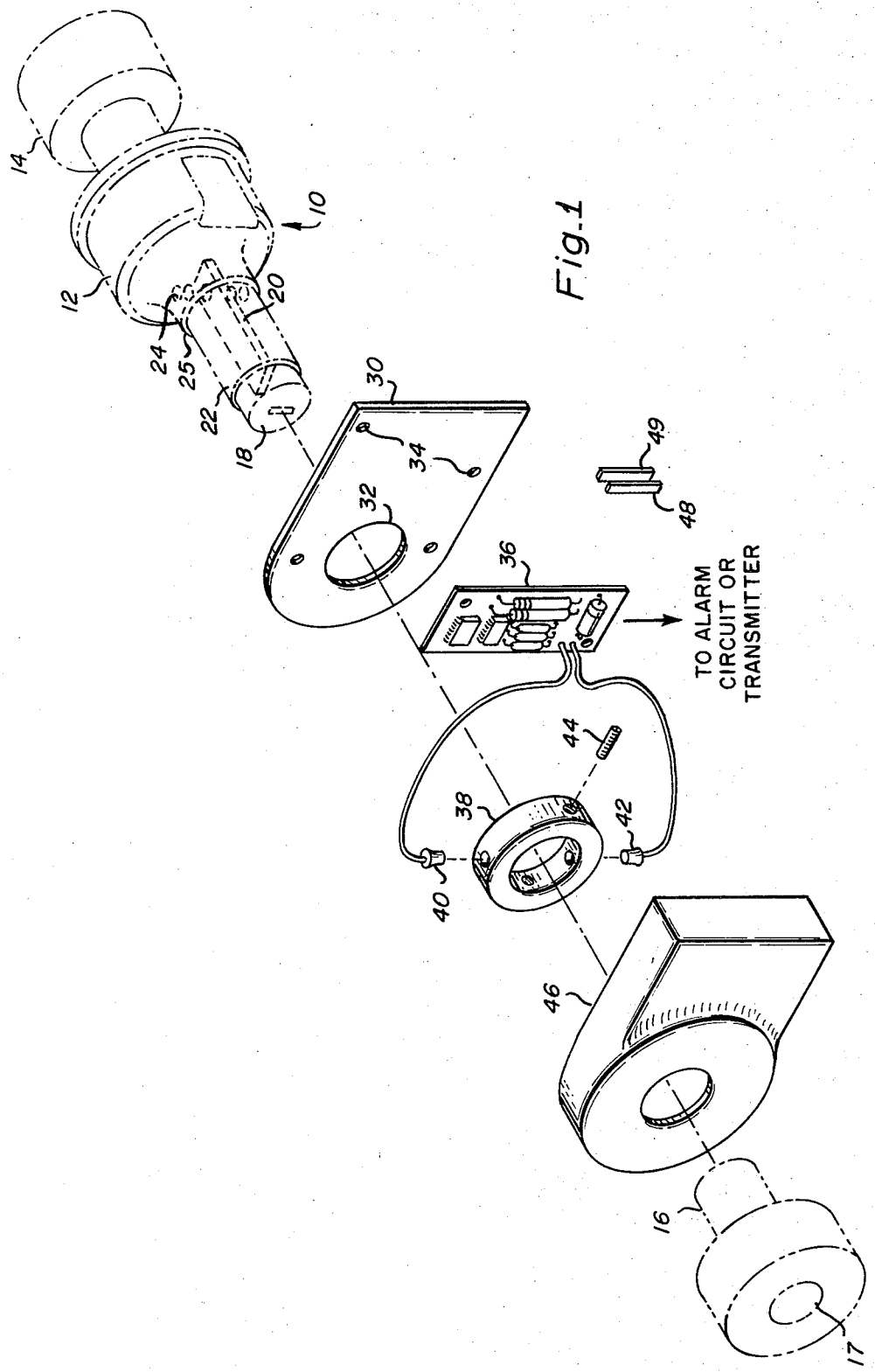

14
10
12
20
24
25
22
18
30
34
32
49
48
36
TO ALARM CIRCUIT OR TRANSMITTER
44
38
42
40
46
16
17

Fig.1

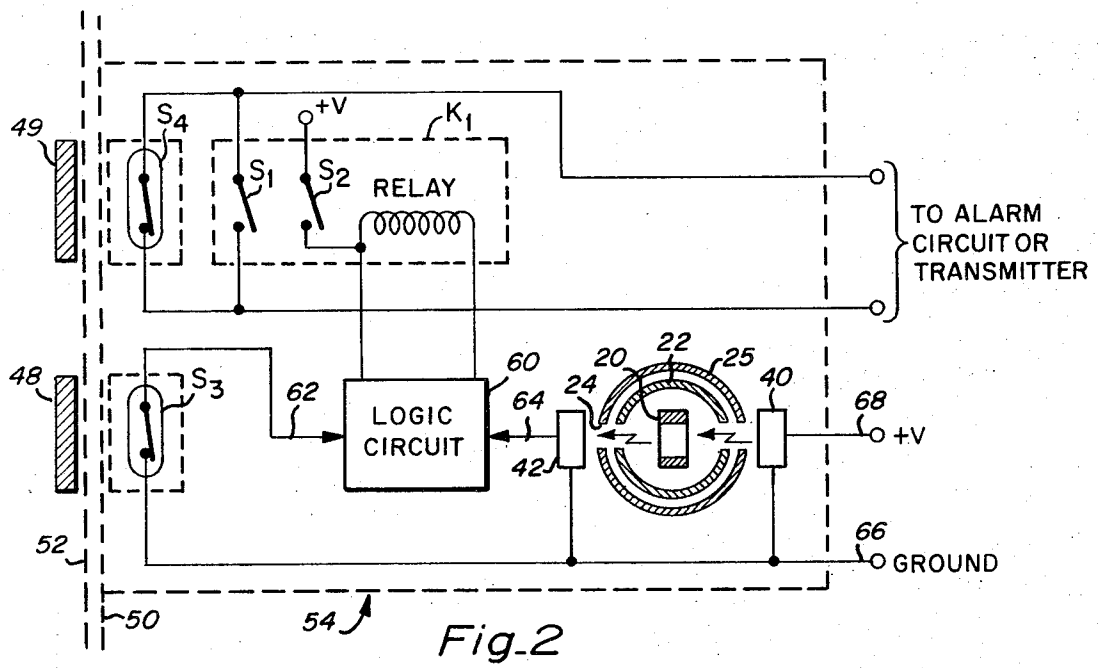

49
S4
+V
K1
S1
S2
RELAY
TO ALARM CIRCUIT OR TRANSMITTER
48
S3
62
LOGIC CIRCUIT
60
64
20
22
25
24
40
42
68
+V
52
66
GROUND
50
54

Fig_2

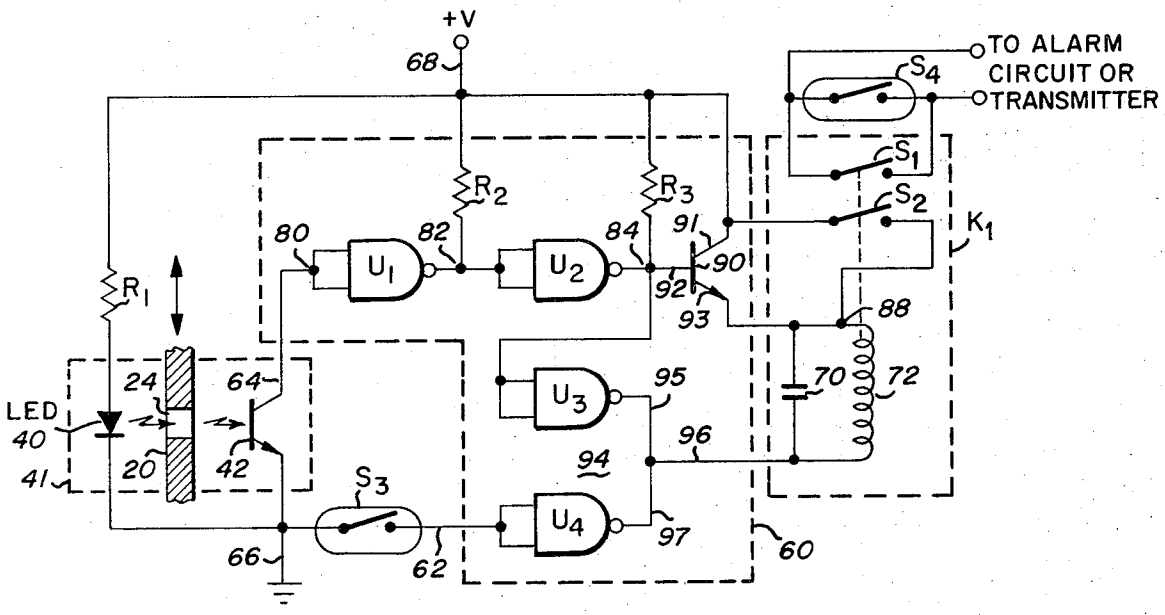

+V
68
TO ALARM CIRCUIT OR TRANSMITTER
S4
S1
S2
K1
R2
R3
80
82
84
91
U1
U2
90
92
93
R1
88
24
64
U3
95
70
72
LED
40
41
20
42
94
96
S3
U4
97
66
62
60

Fig_3

INTRUSION ALARM ACTUATING APPARATUS

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates generally to intrusion alarm apparatus and more particularly to apparatus for use in combination with a closure locking mechanism to detect a forced opening of the closure and to actuate an alarm circuit or transmitter thereby providing authorized entry/exit control.

2. Description of the Prior Art

With the ever increasing incidence of unauthorized entries and burglaries, more and more people are installing anti-intrusion alarm systems in their homes, offices and storage facilities. The principle intent of such devices is typically to ring an alarm, turn on lights, notify a central station, or a combination of these so as to deter the intruder from entering the premises.

Many devices of this type have been heretofore proposed including those devices disclosed in the following recent United States patents: Bireenkott U.S. Pat. No. 3,327,300; Hawkins U.S. Pat. No. 3,623,062; Fontain U.S. Pat. No. 3,623,063; Haywood U.S. Pat. No. 3,643,249; Frank U.S. Pat. No. 3,704,460 and Pecott U.S. Pat. No. 3,723,682. Such apparatus however, usually suffers from disadvantages such as (1) being rather cumbersome, (2) not being readily integratable into an overall alarm system, (3) requiring separate actuating keys or other hardware, (4) not an integral part of a standard door mechanism, or (5) does not provide automatic/inherent false alarm protection, i.e., the user may inadvertently cause a false alarm.

In some cases, operation of the device is even dependent upon a time delay to enable an authorized entrance to be made. This of course can be equally advantageous to an unauthorized intruder in that it gives him time to de-activate the alarm after having made his entry.

SUMMARY OF THE PRESENT INVENTION

It is therefore an object of the present invention to provide a sensing apparatus for an entry control system which is relatively inexpensive, fool-proof, and readily integratable with ordinary door locking hardware so as to be armed and disarmed in the operation normally used to lock and unlock the door.

In accordance with the presently preferred embodiment, a sensing apparatus enclosed in a small attractive housing is attached to standard readily available door-locking hardware or the like, and includes simple magnetic door closure sensing switches, a photo-sensitive locking mechanism detector, and compact electronic logic circuitry combined in such a manner as to simultaneously detect the door closure and condition of the locking mechanism, and to actuate either an external hard-wired alarm circuit, or a radio frequency transmitter used as part of a wireless alarm system, should the door be opened without first being unlocked in the normal manner.

Among the advantages of the present invention are that the device is fool-proof and false alarm proof because once installed, the use of the ordinary key locking and unlocking of the door activates and deactivates the sensing apparatus. In addition, the apparatus is inexpensive, it does not require additional mechanical key-locking structure, and may be affixed directly to or made an integral part of a standard door lock. Furthermore, it can be made pleasing in appearance and is easy to install even on pre-existing hardware.

These and other advantages of the present invention will no doubt become apparent to those of ordinary skill in the art after having read the following detailed disclosure of a preferred embodiment which is illustrated in the several figures of the drawing.

IN THE DRAWING

FIG. 1 is an exploded view illustrating the operative components of a preferred embodiment of the present invention and their association with standard lockable door hardware;

FIG. 2 is a schematic representation for illustrating generally the operative components of the preferred embodiment; and

FIG. 3 is a more detailed circuit diagram illustrating the several components of the preferred embodiment.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring now to FIG. 1 of the drawing, a typical, standard door lock structure **10** is shown in dashed lines and including a lock housing **12,** outside door knob **14,** and inside door knob **16** including an opening **17** for receiving a locking button **18.** Attached to locking button **18** is a locking shaft **20** which passes through a cylindrical sleeve **22** to which the knob **16** is attached. The only modification of this structure required to accomodate the present invention is the drilling of aligned holes **24** through the neck **25** of housing **12,** sleeve **22** and shaft **20.** The holes are aligned when button **18** is in the locked position.

The structure of apparatus in accordance with the preferred embodiment is shown in solid lines and includes a backing plate **30** having an aperture **32** for receiving the sleeve **22** and housing neck **25,** and for attachment to the door itself in flush relationship by means of screws or the like passed through the openings **34.** A circuit board **36** for carrying several electrical, electromagnetic and electronic components which will be described in detail below is attached to the rightmost side of plate **30,** and a sensor which carries a photo-transistor **40** and a light emitting diode **42** is provided to telescope over sleeve **22** and onto neck **25** of housing **12** so that the optical of LED **42** and photo-transistor **40** are coincident with the axis of the apertures **24.** Sensor ring **38** may be affixed to neck **25** by means of one or more set screws **44.** Once this structure is affixed over the locking mechanism, a suitable decorative cover or escutcheon **46** is snapped into engagement with plate **30** and the interior door knob **16** is snapped into place on sleeve **22.** A pair of permanent magnets **48** and **49** are also provided for mounting in or on the door-jam adjacent the closed door position of a pair of magnetic reed switches S_3 and S_4 carried by circuit board **36.** Alternatively, a single magnet could be used if the switches S_3 and S_4 are mounted close enough together.

Turning now to FIG. 2 of the drawing, the edge of a suitable closure, such as a standard door, is depicted by the dashed lines **50,** the mating wall or door-jam is depicted by the dashed lines **52,** and the apparatus of the present invention is shown enclosed in the dashed lines

54. Note that the apertured neck 25 of housing 12, the sleeve 22 and the locking shaft 20 are also diagrammatically shown within the right side of the housing closure to aid in the description. In addition, the permanent magnets 48 and 49 are shown mounted in the door jam 52 to the left of the magnetic reed switches S_3 and S_4 which are disposed on the left side of enclosure 54. LED 40 is shown mounted on one side of the apertured locking mechanism and the light receiving photo-transistor 42 is shown on the opposite side.

The electrical apparatus carried by circuit board 36 includes a relay K_1 having a pair of switches S_1 and S_2, and logic circuitry 60 which will be described below. As indicated, switch S_4 is connected to an external hard-wired alarm circuit, usually in a series circuit connection, or to an rf transmitter, and relay switch S_1 is connected in parallel with switch S_4 to provide an overriding function which in effect disables switch S_4 so that it cannot actuate the alarm circuit. Switch S_2 provides a latching circuit for relay K_1 and is connected between one side of relay coil 72 and a voltage supply +V as will be described with reference to FIG. 3 below. Relay coil 72 is coupled to logic circuit 60 as indicated. Logic circuit 60 is provided with two input terminals 62 and 64. Terminal 62 is connected through reed switch S_3 to a circuit ground line 66 while input terminal 64 is coupled through light receiver 42 to ground line 66. LED 40 is connected between voltage supply terminal 68 and ground line 66.

In FIG. 3 of the drawing, a more detailed electrical schematic of the circuit shown in FIG. 2 is provided for use in describing the operation of the preferred embodiment. Note that components in common with the FIG. 2 illustration have common indicating numerals. The lock detecting means 41 includes the LED 40 and a photo-sensitive transistor 42. A resistor R_1 connects the anode of the light emitting diode 40 to voltage supply terminal 68 and acts as a current limiting device therefore. The cathode of LED 40 is connected to circuit ground at 66. The collector of phototransistor 42 is connected to input 64 of logic circuit 60 while its emitter is connected to ground 66.

In addition to switches S_1 and S_2, relay K_1 includes a capacitor 70 and an actuating winding 72. Switch S_1 is connected across the door closure responsive to magnetic reed switch S_4. Latching switch S_2 is connected between voltage supply terminal 68 and the upper side of relay coil 72. Capacitor 70 is connected in shunt across coil 72 and serves to provide a very small delay in the energizing as well as releasing action of coil 72 as will be described below.

Logic circuit 60 includes four inverting operational amplifiers $U_1 - U_4$ with uncommitted collector output stages, a driver transistor 90, and a pair of resistors R_2 and R_3 which serve as output loads for U_1 and U_2.

Inverting amplifiers U_1 and U_2 are connected in series between input terminal 64 and the base 92 of driver transistor 90. Their function is to provide amplification of the input signal developed by photo-transistor 42 to raise the signal to a level sufficient to drive transistor 90.

The inverting amplifiers U_3 and U_4 are connected in an OR configuration to provide a NOR gate 94 with one input being responsive to the output of lock detecting means 41 as applied at input terminal 64 and the other being responsive to the input developed by closure position switch S_3 at input terminal 62. The output 96 of NOR gate 94 is coupled to the bottom side of relay coil 72. The collector 91 of driver transistor 90 is connected to power supply terminal 68 and one side of switch S_2 and the emitter 93 thereof is connected to the upper side of relay coil 72. The operational states of this circuit may be understood generally by referring to the following table:

OPERATION

Switch	Door closed Lock locked	Door closed Lock unlocked	Door open Lock unlocked	Door opened then Lock locked	Door closed with Lock locked	Door opened with Lock locked
S_1	open	closed	closed	closed	open	open
S_2	open	closed	closed	closed	open	open
S_3	closed	closed	open	open	closed	open
S_4	closed	closed	open	open	closed	open
Alarm	no	no	no	no	no	yes

More specifically, the operation of the search may be explained by considering the actual circuit function understanding that when the door lock is in the locked position, the apertures 24 in the locking structure are aligned so that light from LED 40 illuminates photo-transistor 42; relay switches S_1 and S_2 are normally open; and reed switches S_3 and S_4 are open when the door is open and closed when the door is closed.

In the first case illustrated in the above table, the door is closed and the lock is locked. Accordingly, light from LED 40 causes photo-transistor 42 to be in its conductive state (developing a locked signal) to pull circuit node 80 to a low state in turn causing the output of amplifier U_1 to produce a high state at node 82 which in turn causes amplifier U_2 to develop a low state at node 84. Since transistor 90 is connected as an emitter follower, the potential at node 88, the top of relay coil 72 is also low. Output terminal 95 is low because the collector load, relay coil 72, of U_3 and U_4 is low. Since the potential at node 88 is low and terminal 96 is also low (the logic circuit develops an unlocked signal), relay K_1 will not be energized and accordingly, switches S_1 and S_2 will remain open. However, since the door is closed, and accordingly, door switch S_4 is closed, the alarm circuit will be uninterrupted and no alarm will be sounded.

If now the lock is unlocked, with the door closed, locking shaft 20 will be shifted in position so as not to permit any light from LED 40 to strike photo-transistor 42 and accordingly, it will become non-conductive (developing an unlocked signal), causing a high to be developed at input 64 thereby causing inverting amplifier U_1 to develop a low at node 82 which in turn causes amplifier U_2 to develop a high at node 84. This high biases transistor 90 conductive so as to raise the potential of node 88 at the top of relay coil 72 to approximately +V. The high condition at node 84 also causes the output developed by inverting amplifier U_3 at 95 to go low. As this occurs current flows through relay coil 72 causing it to close relay switches S_1 and S_2. Note however

that the door responsive switches S_3 and S_4 are also closed since the door is closed, so once again, the alarm circuit is not open and no alarm will be sounded.

If now the door is opened, the only change effected will be that switches S_3 and S_4 open with the result being that input **62** goes high causing amplifier U_4 to develop a low at **97.** This however has no effect upon the operation of relay K_1 and S_1 and S_2 remain in their closed positions thereby shunting the open switch S_4 and preventing the alarm circuit from being opened.

With the door now in its open position, if the lock is locked, the following operational sequence will occur:

As shaft **20** moves into the lock position, the apertures **24** again align so as to permit light from LED **40** to impinge upon photo-transistor **42** causing it to conduct and pull the input at **64** and node **80** low. As before, this causes the base **92** of transistor **90** to be pulled low rendering the transistor non-conductive. At the same time node **95** is prevented from going high because of the NOR gate configuration. However, since switch S_2 is in the closed position, it will provide a latching action which will continue to cause relay coil **72** to be energized, thereby keeping switch S_1 in position to shunt switch S_4 and prevent the alarm circuit from being interrupted.

Closure of the door will have the effect of closing switches S_3 and S_4. Note that as switch S_3 closes, the input at **62** is pulled low causing the output of amplifier U_4 to go high at **97,** thus interrupting current through coil **72** of relay K_1 and allowing switches S_1 and S_2 to return to the open position. However, since switch S_4 is now closed, the alarm circuit will not be interrupted and no alarm will be sounded.

With the door in the closed position, and the lock locked, S_1 is open while S_4 is closed, this means that if the door is now forced open, no circuit operation will occur to actuate relay K_1 so switch S_1 will remain open, and the opening of the door will cause switch S_4 to open, thereby breaking the alarm circuit and causing the alarm to be sounded.

It is important to note that what has thus been provided is an alarm triggering circuit which is capable of arming any suitable alarm circuit as the door is locked and dis-arming the alarm circuit in so far as the door is concerned, as the door is unlocked. No additional operative steps are required to make the alarm circuit respond to a forced opening of the door, and so long as the alarm circuit is operational any forced entry of the door will cause the alarm circuit to be actuated. The only moving parts involved in the detector are the switches S_1–S_4 and none of these require physical contact with a stationary member as the door is closed. Accordingly, the operative lifetime of the circuit will be optimum and little, if any, maintenance will be required.

Although the preferred embodiment utilizes a light responsive detecting means for sensing the locked condition of the door locking mechanism, it is also anticipated that other magnetic, electrical or electromechanical sensing means might likewise be adapted for utilization in the circuit. Similarly, equivalent means may be substituted for the magnetic reed switches S_3 and S_4 where deemed appropriate.

As another alternative, the detecting structure could be built integral with the locking mechanism rather than as an adjunct thereto.

Accordingly, it is to be understood that the above described preferred embodiment is disclosed by way of illustration only and is in no way intended to be limiting. Furthermore, the appended claims are intended to be interpreted as covering all alterations and modifications of the present invention which fall within the true spirit and scope of the invention.

What is claimed is:

1. Apparatus for use in combination with a closure locking mechanism to detect a forced opening of the closure and to actuate an alarm circuit, comprising:

lock detecting means for determining whether the locking mechanism is in a locked state or an unlocked state and for developing corresponding lock state signals;

first closure detecting means for determining whether the closure is in an open position or in a closed position and for developing corresponding closure position signals;

second closure detecting means for actuating the alarm circuit when said closure is in said open position;

over-ride means for selectively preventing said second closure detecting means from actuating said alarm circuit; and

logic means responsive to said lock state signals and said closure position signals and operative to actuate said over-ride means to prevent said second closure detecting means from actuating said alarm circuit as said closure is opened unless said closure is moved from the closed position to an open position with said locking mechanism in its locked state.

2. Apparatus as recited in claim **1** wherein said lock detecting means includes a light source and a light detector in combination whereby the presence or absence of light from said source falling upon said detector indicates the operative state of said locking mechanism.

3. Apparatus as recited in claim **1** wherein at least one of said first and second closure detecting means includes an electrical switching means actuated by the opening and closing of said closure.

4. Apparatus as recited in claim **3** wherein said electrical switching means includes a magnetically actuated switch carried by said closure, and a magnet affixed to a wall for receiving said closure and in a position for actuating said switch when said closure is in the said closed position.

5. Apparatus as recited in claim **1** wherein said second closure detecting means includes a first electrical switch connected in said alarm circuit, and wherein said over-ride means includes a relay having a second electrical switch connected in parallel with said first switch.

6. Apparatus as recited in claim **1** wherein said logic means includes a NOR circuit having one logic gate responsive to said lock state signals and another logic gate responsive to said closure position signals.

7. Sensing apparatus for detecting unauthorized opening of a closure and for actuating an alarm device, comprising:

first means responsive to an open condition of said closure and operative to actuate said alarm device;

second means responsive to the operative state of a closure locking mechanism and operative to de-

velop an unlocked signal when said locking mechanism is unlocked;

third means responsive to the position of said closure and operative to develop closure position signals including an open signal when said closure is open and a closed signal when said closure is closed;

logic means responsive to said locked signal and said closure position signals and operative to develop an actuating signal when said locked signal is developed and said closure position signal changes from said closed signal to said open signal; and

fourth means responsive to said actuating signal and operative to disable said first means to prevent said first means from actuating said alarm device as said closure is opened.

8. Sensing apparatus as recited in claim **7** wherein said first means includes a first switch forming a part of the actuating circuit of said alarm device, said first switch having one switching position when said closure is open and having another switching position when said closure is closed.

9. Sensing apparatus as recited in claim **8** wherein said fourth means includes a second switch connected in shunt with said first switch, said second switch having one switching position when said actuating signal is developed and having another switching position when said actuating signal is not developed.

10. Sensing apparatus as recited in claim **7** wherein said second means includes an opto-electrical device which is positioned relative to a moving part of said locking mechanism to develop said unlocked signal when said moving part is in an unlocked position and to develop said locked signal when said moving part is in a locked position.

* * * * *