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(54) **Warning light system.**

(57) The present invention provides alarm apparatus comprising at least one light source (preferably an electric light bulb), a detection circuit (preferably a microphone), and a power source therefor, the light source being adapted to attract attention and to be activated when the detection circuit detects a predefined signal, wherein the detection circuit is maintained in constant ready condition and the predefined signal is emitted by a hazard warning device, such as a smoke detector, the apparatus serving to reduce response time before activation of the warning light by being on constant standby and being useable with existing hazard warning devices.

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WARNING LIGHT SYSTEM

The present invention relates to hazard warning devices comprising a light source and a detection circuit, the light source being adapted to attract attention and to be activated when the detection circuit detects a predefined signal.

Many devices have been constructed to alert occupants of a home or other building when smoke is detected and to give warning of such. Some of these include well known smoke detector devices, usually battery operated and, when activated by smoke or fire, produce an easily recognisable alarm noise intended to alert persons who hear the noise to a potentially dangerous condition. There are also such devices which activate a light producing device to give a visual alarm.

One known form of such a smoke alarm warning device is disclosed by Skarman et al. in U.S. Patent No. 4,570,155, disclosing a device that includes a portable light source for producing emergency illumination of hallways and similar exit areas when a main power supply fails, such as during a fire. This device includes a strobe circuit which periodically activates a detection circuit to monitor and respond to any occurrence of an audio smoke detector signal.

Other known prior art devices of some interest are disclosed in Todd U.S. Patent No. 4,524,304 and Scott et al. U.S. Patent No. 4,258,291. Neither, however, discloses a system which both alerts people to the presence of smoke or fire, and also provides a visible flashing warning which may be seen from outside the building.

In a first aspect, the present invention provides alarm apparatus comprising at least one light source (preferably an electric light bulb), a detection circuit (preferably a microphone), and a power source therefor, the light source being adapted to attract attention and to be activated when the detection circuit detects a predefined signal, characterised in that the detection circuit is adapted to be maintained in constant ready condition and in that the predefined signal is emitted by a hazard warning device, especially a smoke detector.

Preferably, but not exclusively, the alarm apparatus is used in remote association with a hazard warning device, as it will often be the case that the best place for the warning light to be situated will not also be the optimum place for detection of the hazard condition. Accordingly, to use a smoke detector as an example, the smoke detector is preferably placed in a high spot, such as a ceiling, as smoke rises and so will be most easily detected there. However, a light, flashing or otherwise, is unlikely to be of much assistance in such a position, and should be placed in a position likely to

attract attention, such as outside the door or in a window, whatever is appropriate.

It may be desirable to employ several alarm devices according to the invention in association with one hazard warning device. Thus, in the above example, one could be placed in the window, and one outside the door, or doors. Further, one detection circuit may serve more than one light source in more than one position, although this may not generally be appropriate, as a greater number of detection circuits will minimise still further any possibility of failure to detect the hazard warning signal. Also, it may be desirable to deploy one or more alarm devices to serve a plurality of hazard warning devices, which warning devices may be keyed to the same or different hazard conditions.

One advantage of the alarm apparatus (also referred to as alarm device or devices herein) of the invention is that it can be installed in localities where there are already hazard warning devices, frequently without any need to interfere in any way with the existing devices. This is of particular advantage to users who do not wish to instal an entire new system.

The constant standby facility of the present invention is important, and is typically achieved by having a trickle feed from an internal power source, such as a battery, to the detection circuit. When a signal is detected, this is amplified by an amplifier circuit preferably incorporating a filter so that only the correct signals elicit a response. On the correct signal, a switching circuit is put into conducting position to activate the light, which is preferably linked to a timer circuit so as to flash.

It will be appreciated that the present invention also provides one or more alarms of the invention in combination, preferably remote combination, with one or more hazard warning devices, especially smoke alarms, the hazard warning device(s) being adapted to emit the predefined activation signal for the alarm(s).

Thus, the aforementioned problems are solved by a system which continuously applies power to a light source activation circuit, which circuit also includes means that responds to audio noise or other signals produced by such as a smoke detector. When a smoke detector produces an audible noise signal, a suitably placed light source is energised thereby producing preferably a flashing light for quick room identification. The light source should be bright enough to draw attention to indicate which areas to search first. When more than one of the present flashing light devices are used in the same home or building, it is possible to have a smoke detector device activate more than one

devices of the invention if desired. If the devices are out of audible range, then this may be done by including radio frequency transmitting means in the smoke detector. In this case, suitable receiving means, such as an antenna, may be installed on the alarm device instead of, or in addition to, a microphone(s) for example. Thus, when the smoke detector activates, it emits radio and audio signals, either of which may be received by the flashing light devices to cause them to activate.

Typically, the flashing light source will be mounted on or near an outside window or at some other highly visible place, and the smoke detector will be mounted near enough to the flashing light source and its associated circuit so that there is little or no chance that the circuit will not be able to respond to a smoke detector signal. Although it is contemplated to have the flashing light and its associated detection circuit constructed as separate units for mounting apart from each other, possibly even in different rooms under some circumstances, it is also contemplated and in most cases it is preferred to have the light source and its circuit combined in a common housing. The important thing is that the detection circuit be located so as to be able to and be activated by signals produced by the smoke detector so that its operation does not depend on any other signal or circuit condition being activated. By so providing, the chances of failure are greatly reduced.

The devices of the invention are preferably used in conjunction with a smoke detector. It is preferred that the devices include a light source for mounting in a window or at some other highly visible location near where a smoke alarm is located so that, if the smoke alarm activates due to detecting smoke or fire and produces audible signals, the light source will activate, preferably producing light flashes, to call attention to the relevant area, such as a room or rooms where persons may be located, to facilitate timely rescue.

The present invention is especially useful as an aid in locating children, disabled persons and others in a building who may not be able to understand the need or be able to exit the building, or who may require assistance to exit.

The present device is advantageously placed in a room where there is a smoke detector and where potential fire victims or fire damageable items are located, such as a room where a child is sleeping, so that when the smoke detector activates, a flashing light lets outsiders know where the dangers and possible victims are. The device may also be located where there are other items of value that need to be rescued. Thus, the present invention provides warning means intended to identify where there may be a need for help or attention in order to minimise time taken in a hazard

zone.

In an alternative embodiment, the present invention provides a system for producing a flashing light signal to identify a location where a smoke detector has sensed a potentially dangerous condition and has produced an audible signal to indicate the condition comprising flashing alarm producing means including a light source, a source of energy, a timer circuit, electric switch means having power connections and a control connection, circuit means responsive to audible signals produced when the smoke detector senses a potentially dangerous condition, means connecting the timer circuit and the power connections of the switch means in series across the energy source, the circuit means responsive to the audible signals including a microphone located to respond to the audible signals and amplifier circuit means connected between the microphone and the control connection of the electric switch means, and a circuit connection between the energy source and the amplifier circuit to maintain the amplifier circuit in a ready condition to amplify a signal produced when the microphone responds to an audible signal from the smoke detector.

In a further embodiment, the present invention provides a warning light device for mounting in a visible location so that, if a smoke detector activates, a light signal will be emitted from the device and which may be observed, comprising: detection means for detecting when a smoke detector activates and for producing an output; filter means having an input connected to the output of the detection means for determining whether the output of the detection means is within a predetermined frequency range, the filter means connected to an energy source and maintained in a ready condition;

a timing circuit and switching means for activating the timing circuit when the filter means determines that the output of the detection means satisfies predetermined conditions; and

a light source operatively connected to the timing circuit, the light source producing a light signal whenever the timing circuit is activated.

In a yet further embodiment, the present invention provides a flashing alarm device responsive to signals produced by a smoke detector when the smoke detector responds to a smoke condition comprising an alarm circuit including signal responsive means located in position to respond to signals produced by the smoke detector, the alarm circuit including an amplifier circuit for amplifying signals received from the smoke detector, a source of energy including means operatively connecting the energy source to the amplifier circuit to maintain the amplifier circuit in a continuous standby condition, a switching means circuit having a con-

trol input on which output signals produced by the amplifier circuit are applied to change switching circuit from a non-conducting to a conducting condition, an electric light and a timer circuit connected in series between the source of energy and the switching circuit. the timer circuit operating to energise and de-energise the electric light to produce flashes of light whenever the switching circuit is in its conducting condition.

The devices of the present invention preferably have their own power source, such as an inexpensive 9V battery, which circuit, when not responding to a smoke detector signal, continuously supplies a small trickle of energy to the light activation and signal detection circuit, usually to an operational amplifier (Op-Amp) circuit, which is thereby maintained in a ready condition. The amplifier circuit typically draws a small amount of current, in the range from about 2-5 μ A, which is not enough to represent a substantial drain on the battery except over a very long time period, such as a year or longer.

By providing this small trickle of charge constantly to the amplifier circuit, the amplifier is kept in a constantly ready condition, this being important, in that it maintains the circuit in a responsive condition so that, as soon as the smoke detector activates, the signal produced will cause the flashing light to activate without delay and without requiring periodic circuit testing. This also means that only one condition, namely detection of activation of a smoke detector, need take place for the flashing light to commence flashing. This, in turn, means that the light source will start to flash sooner after smoke is detected than would be the case with known devices.

Typically, with the devices of the present invention, the input of the Op-Amp is connected through a filter circuit to the output of a microphone which responds to audio signals produced by a smoke detector, and the amplifier produces an output whenever the microphone senses such a signal. The output of the amplifier is connected to the input of a bandpass filter designed to pass signals having a frequency within some predetermined range. The outputs of the bandpass filter are applied as inputs to a detector circuit which converts the alternating filter outputs to a direct current (d.c.) signal which is used to activate or close a switching device. When the switch is closed, it completes a circuit between a timer circuit, a power source and a light source, which causes the light source to flash. The timer circuit controls the flashing rate or frequency of the light source. As soon as the smoke detector is activated by smoke, the light source will immediately commence flashing, indicating where assistance is required.

The devices of the invention may also option-

ally include an on-off switch connected into the circuit between the power source and amplifier to enable the user to control when power is to be supplied to the circuit. This may be done to save battery power when the room is not occupied and enables the user to turn the device off when the reasons for using it no longer exist.

Thus, the devices of the invention require relatively little energy to remain in an active standby condition, and time lapses, between when an alarm condition is sensed by a device such as a smoke detector and when a flashing light warning condition, are minimised.

The present invention will now be illustrated with reference to the accompanying drawings, in which:

Fig. 1 is a perspective view of a part of a room equipped with a smoke detector and a flashing alarm of the present invention;

Fig. 1A is a fragmentary view from outside of a window having the flashing alarm mounted therein;

Fig. 2 is a block diagram of the circuit for the alarm of Fig. 1, an alternate embodiment being shown in dotted outline; and

Fig. 3 is a schematic circuit diagram showing in more detail the circuit of Fig. 2.

Fig. 1 shows a portion of a room equipped with an alarm system 10 constructed according to the present invention. The alarm system 10 includes a smoke detector 12 which may be of conventional construction and is capable, when smoke or fire is detected, of producing an easily recognisable audio signal, usually of relatively high frequency. Such signals are usually irritating noise signals intended to attract attention and action. The smoke detector is shown installed on the ceiling usually at a central location in the room although any convenient location may be used.

The system 10 also includes a flashing alarm portion 14 which is shown mounted on or adjacent to a window, preferably an external window. The alarm 14 has a light bulb 16 mounted thereon or therein in position to produce visible light outside the room whenever it is energised. The alarm 14 may be mounted on a window 18 such as by being attached to window pane 20 using one or more suction cups 21, as shown in Fig. 1A, or it may be attached or mounted in some other way as by being attached to the window frame 22 or jamb 24 using means such as a threaded fastener. Alternatively, the device may be suspended on a cord or wire from the upper frame member 26, if desired, provided that the bulb 16 is visible from outside the room and that the alarm is located close enough to the smoke detector 12 to be able to respond to the noise signals produced thereby. It is also possible to mount the smoke detector in

the same housing as the alarm although this is usually not preferred unless the device is for location in an area where the presence of fire or smoke is best detected.

Fig. 2 is a block diagram of the circuit 30 for the flashing alarm portion 14 of the present system. The circuit includes a microphone 32 capable of responding to the noise signals produced by the smoke detector 12. The microphone 32 produces outputs which are applied to the input of an amplifier circuit through a filter circuit, shown as operational amplifier (Op-Amp) 34, which has a power input connection 36 to a battery 38. This power connection is important because it means the amplifier 34 will be maintained in a constantly ready condition. The amplifier 34 and the battery 38 also have ground connections as shown. The output 40 of the amplifier 34 is connected to a bandpass filter circuit 42 which has its output connected to a detector circuit 44 which, in turn, is connected to a low pass filter circuit 46. The output of the low pass filter circuit 46 is connected to a control electrode or gate 48 of a switching device 50 which may be an electronic switching device such as a MOSFET or an SCR.

The switch 50 is connected in series with a timer circuit 52 and the battery 38. The timer 52 is in turn connected to ground through the light source 16. The frequency of the timer circuit 52 depends on the time constant thereof. The time constant should be selected to produce a light flashing rate to attract attention and indicate an emergency.

The Op-Amp circuit 34 receives a constant trickle of current from the battery 38 so that it is maintained in a constant ready condition. Thus, whenever the microphone 32 responds to a smoke detector noise signal, the amplifier will immediately produce an output to cause the switching circuit 50 to close and to thereby activate the timer 52 to cause the light 16 to flash on and off. The timer, not the switch, flashes the light 16, but the timer is only able to flash the light when the switch 50 is closed. This is in contrast with prior art circuits which require several different things to take place before an alarm condition may be produced. Further, while the circuit is in standby condition, it draws relatively little current and hence may operate for a very long time, such as a year or longer, without losing power.

Many variations of the block diagram circuit shown in Fig. 2 are possible. For example, the amplifier 34 may be integrated into the microphone 32, in which case power may be supplied directly to the microphone 32. Another possibility is to include a radio transmitter in the smoke detector and receiver means such as an antenna 54 (Fig. 2) in the flashing light unit so that if the smoke detec-

tor activates, it will transmit radio frequency signals that may be received by any alarm device in range. The receiver means thereby operates the circuit in a manner similar to the microphone by causing the switch 48 to close and activate the circuit of the timer 52 and the light bulb 16. One advantage of using RF transmissions is the substantial increase in range that may be used between the smoke detector and the alarm device, such as in different rooms separated by sound-proofing.

Fig. 3 shows more circuit details of the present device and shows the microphone 32 (or antenna 54) connected to an amplifier input circuit which includes a sensitivity control potentiometer 60, and an input filter circuit formed of capacitors 62 and 64 and resistors 66 and 68 connected as shown. Another capacitor 70 for the bandpass filter 42 has its output side connected to the detector circuit 44 formed by diodes 72 and 74. The output side of the detector 44 is connected to the low pass filter 46 formed of capacitors 76, 78 and resistor 80. The output of the filter 46 is connected to the gate or base electrode 48 of the MOSFET 50.

The timer circuit 52 includes a timer device 82 connected to resistors 84, 86 and capacitor 88 as shown. The light 16 is also connected between the power source or battery 38 and the output 90 of the timer device 82. The timer device 82 may be in the form of an integrated circuit which operates in conjunction with the resistors 84, 86 and the capacitor 88 as a stable multivibrator or flasher circuit. Since the MOSFET 50 is in the power supply path of the flasher or timer circuit 52, the light 16 may only be energised to flash when the MOSFET 50 is on or closed. This may only occur when an audible signal of a frequency that matches the frequency range of the band pass filter 42 is present and is of sufficient magnitude to reach the trigger potential of the MOSFET. The signal must be present for a long enough duration to allow the low pass filter 46 to pass it on to the MOSFET.

As indicated above, only the amplifier circuit 34 and the timer or flasher circuit 52 drawing power or are able to draw power from the battery 38, the amplifier circuit 34 drawing power continuously and the timer circuit 52 drawing power only when a smoke detector signal is detected. The purpose of the Op-Amp circuit 34 is to amplify the signals it receives, which are relatively small signals produced by the microphone 32 or in the antenna 54, to a level sufficient to make the detector circuit activate the MOSFET switching circuit 50. If the MOSFET is in its conducting condition, it will ground the timer circuit 52. The timer circuit 52, as stated, is connected to the power source and when the MOSFET 50 conducts, power is supplied to the lamp 16 under control of the timer circuit 52. The

timer circuit operates to cause the lamp to flash on and off to provide the desired warning. Thus, once an audible signal is detected by the microphone, the amplifier and the associated circuitry determines whether the signal is within a proper acceptable frequency range, and if it is, converts the signal to direct current and utilises the signal to activate the lamp, thereby giving virtually immediate visible warning.

The use of a crystal microphone capable of responding to audible signals even over a fairly great distance is preferred, and the magnitude of response that is sufficient to cause an alarm condition is controlled by the setting of the potentiometer 60. The potentiometer 60 therefore allows the sensitivity of the system to be adjusted as desired. The capacitors 62, 64 and the resistors 66, 68 in conjunction with potentiometer 60 and the amplifier 34 provide a bandpass filtering function which eliminates responses that are not in the desired frequency range, thereby reducing the likelihood of false alarms. A desired amplifier for this purpose is a simple voltage Op-Amp having a constant gain factor. For example, a gain factor of 1000 means that a 1mV rms input from the microphone 32 will appear as a 1000mV (or 1 volt) rms signal. The other amplifier connections provide a ground reference and a power connection. As stated, with the connections as shown, some amount of power is always provided to the amplifier 34 from the power source, and the Op-Amp 34 will typically draw between about 2-5 μ A when in standby, and this amount of power will not adversely affect the power source except over a very long time period.

The circuits shown in Figs. 2 and 3 may be mounted on a printed circuit board using circuit construction and connection techniques well known in the art. A manual switch 94 may be provided to cut off all battery power to conserve energy when there is no reason to operate the device.

Claims

1. Alarm apparatus comprising at least one light source (preferably an electric light bulb), a detection circuit (preferably a microphone), and a power source therefor, the light source being adapted to attract attention and to be activated when the detection circuit detects a predefined signal, characterised in that the detection circuit is adapted to be maintained in constant ready condition and in that the predefined signal is emitted by a hazard warning device, especially a smoke detector.

2. Alarm apparatus according to claim 1 wherein the light source is adapted to flash when activated.

3. Alarm apparatus according to claim 1 or 2 wherein the detection circuit is remote from the hazard alarm.

4. Alarm apparatus according to any preceding claim wherein the detection circuit is adapted to detect audible signals.

5. Alarm apparatus according to any preceding claim further comprising a switching circuit adapted to be activated by the detection circuit in order to switch on the light source.

6. Alarm apparatus according to claim 5 wherein the switching circuit includes an SCR or is a MOSFET.

7. Alarm apparatus according to any preceding claim further comprising an amplifier circuit, preferably an Op amplifier circuit, to amplify any signal produced by the detector circuit.

8. Alarm apparatus according to claim 7 further comprising a filter circuit, preferably a low pass or bandpass filter circuit, operatively connected to the amplifier to control the frequency range of signals to which the amplifier circuit is responsive.

9. Alarm apparatus according to claim 7 or 8 further comprising means for converting the output of the amplifier circuit to a D.C. signal.

10. Alarm apparatus according to any preceding claim wherein the detection circuit comprises a crystal microphone.

11. Alarm apparatus according to any preceding claim further comprising a housing therefor and, preferably, means for mounting the housing in a window.

12. Alarm apparatus according to any preceding claim wherein the signals produced by the hazard warning device are radio frequency signals and the alarm circuit includes an antenna for responding to the radio frequency signal.

13. A flashing alarm device responsive to audible signals produced by a smoke detector comprising an alarm circuit including a microphone located in close enough proximity of the smoke detector to respond to audible signals produced when the smoke detector senses a smoke condition, an amplifier circuit connected to the microphone for amplifying signals produced thereby when the smoke detector produces an audible output, a source of energy including means operatively connecting the energy source to provide sufficient current to the amplifier circuit to maintain the amplifier circuit in a continuous standby condition, a switching circuit having a control input on which output signals produced by the amplifier circuit are applied to change the switching circuit from a non conducting to a conducting condition, an electric light and a timer circuit connected in series between the source energy and the switching circuit, the timer circuit operating to energise and deenergise the electric light to produce flashes

of light whenever the switching circuit is in its
conducting condition,
said hazard warning device optionally further com-
prising any one or more suitable features, or any
combination thereof, as defined in any preceding
claim. 5

14. One or more alarms according to any pre-
ceding claim in combination with one or more
hazard warning devices, especially smoke alarms,
the hazard warning device(s) being adapted to emit
the predefined activation signal for the alarm(s). 10

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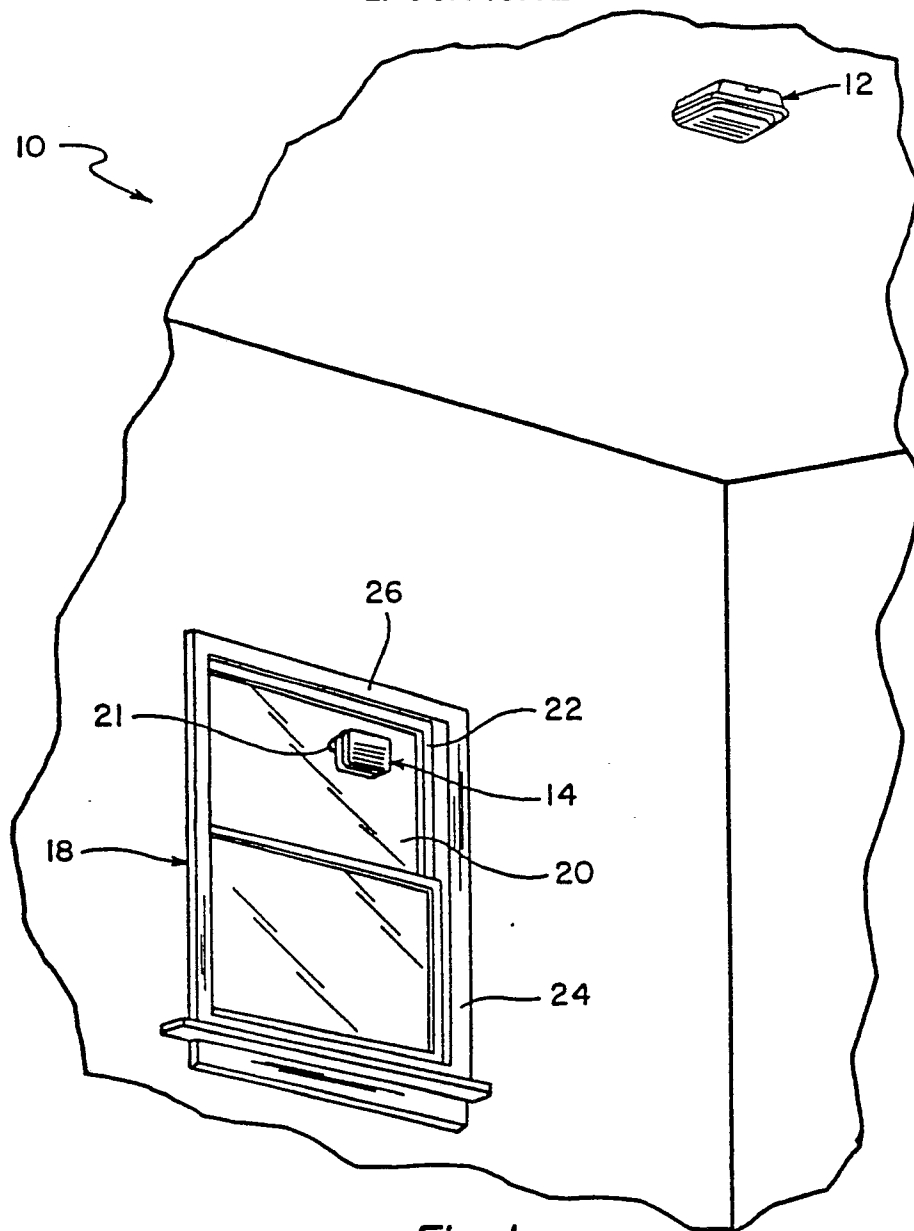


Fig. 1

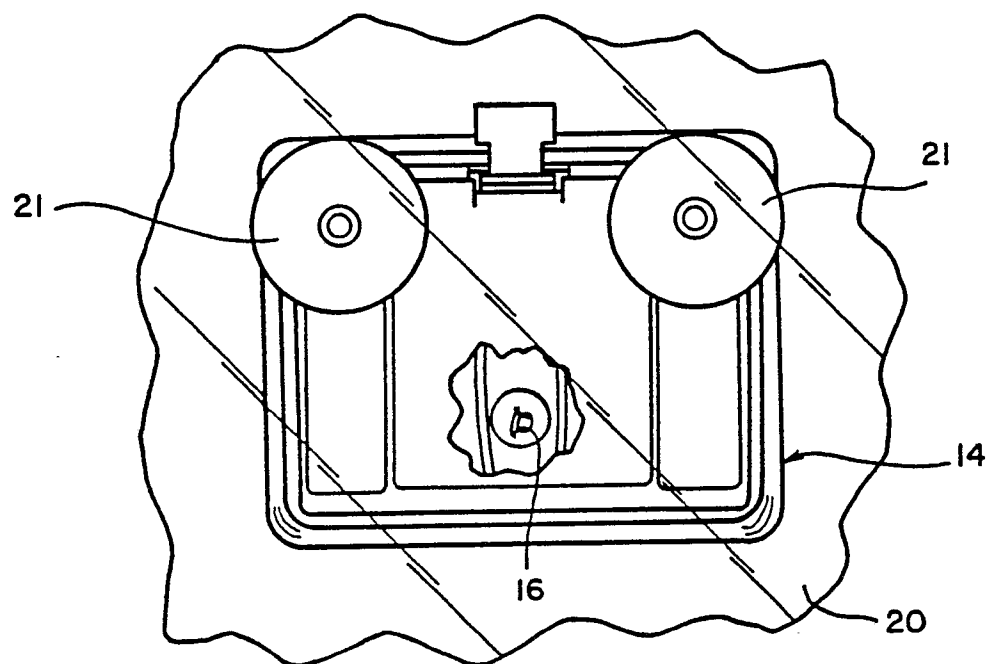


Fig. 1A

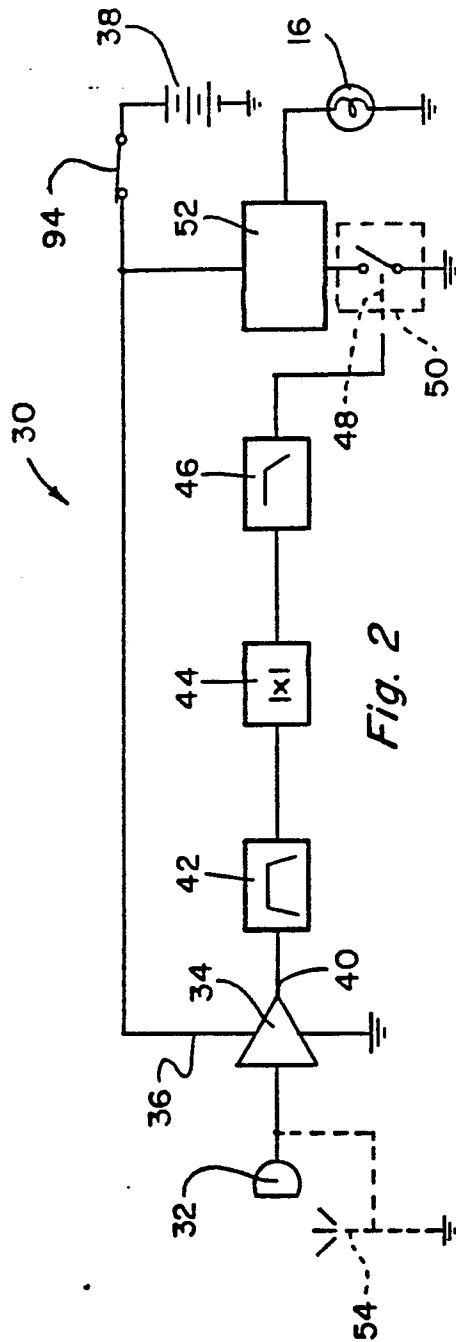


Fig. 2

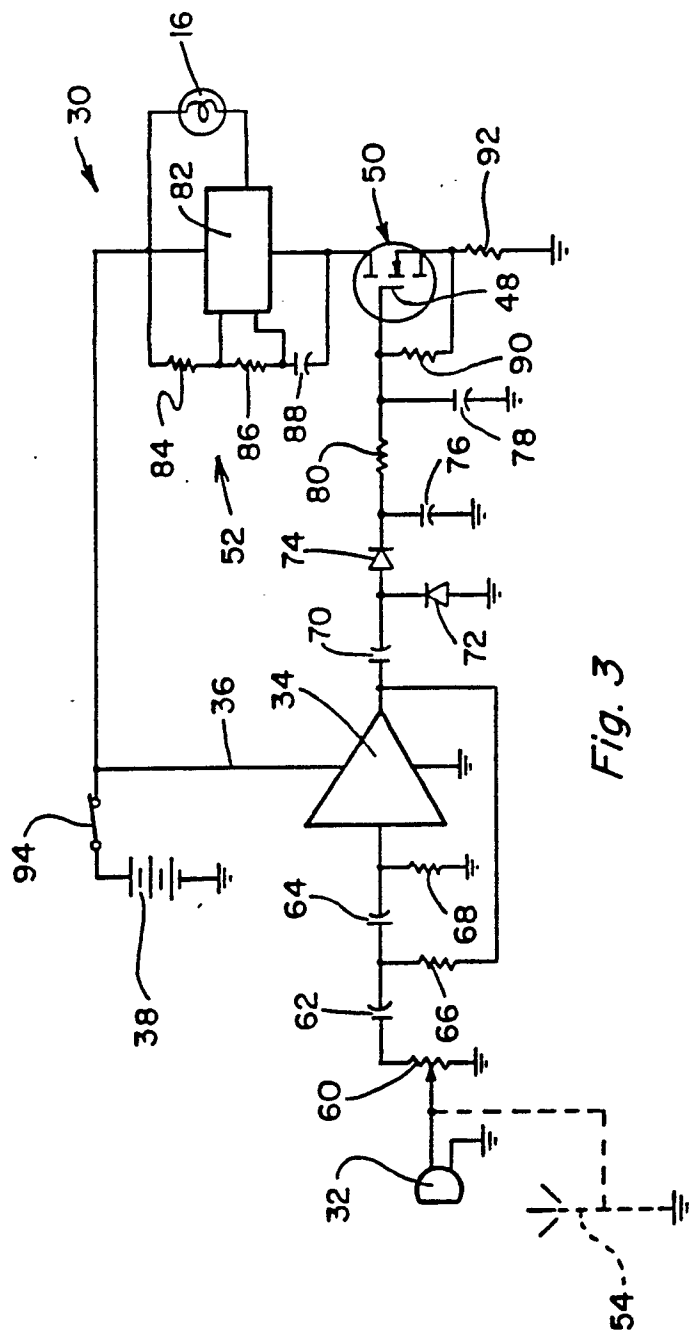


Fig. 3