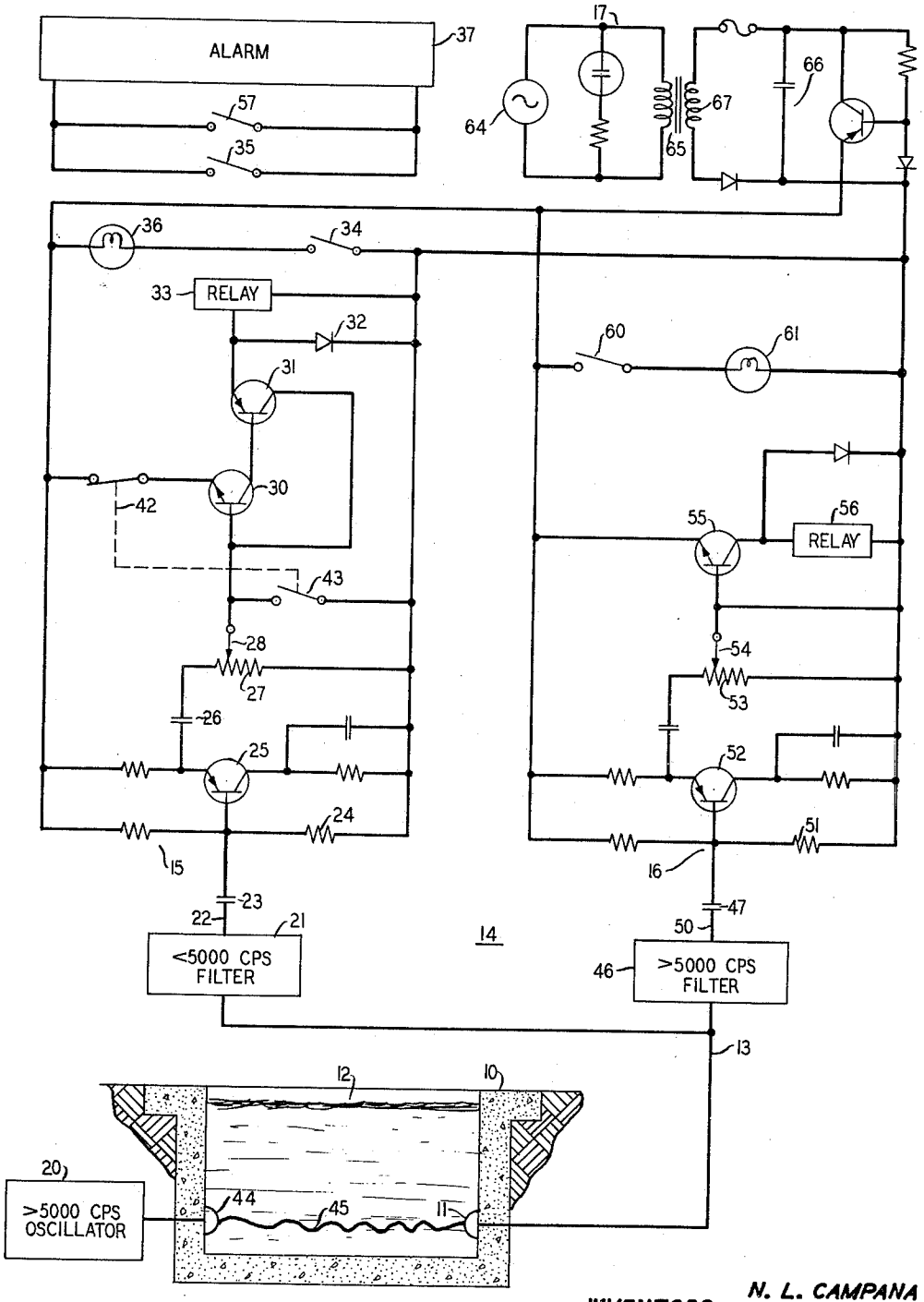
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ALARM SYSTEM

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ALARM SYSTEM

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ABSTRACT OF THE DISCLOSURE

An illustrative embodiment of the invention is installed as a swimming pool alarm. Typically, a child falling into the water or vandals destroying the physical structure of an unattended pool generate sonic disturbances in the water of 5000 cycles per second (c.p.s.) or less. These low frequency signals activate the alarm circuit. To ensure proper functioning, however, sound pulses of more than 5000 c.p.s. are generated continuously in the water by the system. These higher frequency signals are received by a test circuit that keeps the alarm inactive unless either a lower frequency signal triggers the alarm or some failure develops within the system. Transistor or integrated circuit techniques, moreover, are used to achieve maximum system reliability in a swimming pool environment.

BACKGROUND OF THE INVENTION

Field of the invention

This invention relates to alarm systems and, more particularly, to a swimming pool alarm that responds to sonic disturbances, and the like.

Description of the prior art

The dangerous attraction that an unattended swimming pool holds for children is well known. The growing popularity of private swimming pools tends to aggravate the danger because pools of this sort often remain without competent supervision for long periods of time. This danger to children is further enhanced because private pools usually are located in residential neighborhoods where large numbers of vacationing children are likely to be tempted to swim without adequate safeguards during the summer months.

Considered from another viewpoint, vacant swimming pools, either private or public, seem to invite vandalism.

Accordingly, there is a need for an inexpensive and reliable alarm system that will warn of a disturbance at a vacant swimming pool.

In the past, hydrophones have been proposed for installation within these pools. Sonic disturbances registered by the hydrophones and amplified by vacuum tube circuits have been suggested to sound an alarm. These circuits are subject to the usual unreliability that characterizes vacuum tube devices. More particularly, these proposed circuits have been unsatisfactory because of the extreme environmental conditions in which they must operate. Typically, high temperature during summer operation, humidity, corrosion, fungus, and rough handling all tend to shorten the operational lifetime of these circuits and destroy their usefulness in spite of a significant need.

More advanced systems have been proposed in which a body or other object blocking a sonic energy transmission path across the bottom of a pool activates an alarm. Neither the passive hydrophone nor the foregoing signal obstruction proposal, however, provides for a system failure indication. Thus, a fault in the alarm system may be undetected and thereby inadvertently leave the pool

entirely without protection. This is a serious shortcoming, especially because these proposed techniques have depended entirely on less reliable vacuum tube circuits.

The need for an extremely reliable pool warning system has heretofore remained unsatisfied. The requirement for a system failure alarm, moreover, has been completely unrecognized.

SUMMARY

In accordance with one aspect of the invention, a rugged and inexpensive semiconductor circuit is provided for a swimming pool alarm that overcomes the lack of reliability inherent in prior art vacuum tube circuits. Another aspect of the invention provides for the transmission of a high frequency sonic test signal through the pool water. A lower frequency disturbance in the pool activates the alarm or, in response to a fault in the alarm system, the higher frequency test signal deactivates a test circuit that, in turn, operates a separate fault warning alarm as well as the swimming pool alarm.

More particularly, a power supply converts ordinary 110–120 volt, sixty cycle alternating current into an appropriate voltage source for the test signal and alarm system circuits. The alarm circuit comprises a hydrophone that is sonically coupled to the body of water in a swimming pool. Sonic energy registered by the hydrophone in a range that extends from above 5000 c.p.s. to some lower frequency is converted into an electrical signal that is sent through an armored, waterproof cable and a filter section that passes all signals of less than 5000 c.p.s. to the base of a signal amplifying PNP transistor in a circuit located near the pool.

The output from the amplifying transistor is fed to a potentiometer that has a movable tap connected to the base of an NPN transistor. The potentiometer enables the sensitivity or activation threshold of the alarm to be preset.

The NPN transistor is direct-coupled to the base of another PNP transistor. This circuit arrangement provides power to drive a relay in response to a sonic input signal that has a sufficiently low frequency to be passed by the filter and an amplitude that is adequate to exceed the discrimination level set on the potentiometer.

The relay operates makes contacts that complete the circuit for an alarm, as, for example, a light or a bell at some distant location. In this circumstance, the alarm remains energized until a reset switch is operated manually at the circuit near the pool. Thus, to disconnect the alarm and return the system to a nonalarm condition, some person must make a visit to the pool site.

The test circuit comprises a transducer coupled sonically to the body of pool water. The sonic transducer is fed by an oscillator in order to produce sound pulses in the water of a frequency that is greater than 5000 c.p.s.

These higher frequency signals are registered by the hydrophone and applied through the armored cable to a second filter section that passes all signals of a frequency greater than 5000 c.p.s. to the base of an PNP transistor in a test circuit that generally parallels the alarm circuit. The output from the test PNP transistor is coupled to a sensitivity regulating potentiometer that establishes a discrimination threshold for the test circuit.

The adjustable tap on the potentiometer is connected to the base of an NPN transistor. In response to a suitable base input signal, a relay coupled to the test circuit NPN collector electrode is energized. This latter relay, normally energized, operates break contacts that keep the swimming pool alarm inactive.

If the base signal applied to the test circuit NPN transistor is, for instance, interrupted by a defect in the hydrophone, the test circuit relay is deenergized and

completes the circuit for the system alarm and the fault light.

A further aspect of the invention may provide for two alarm indications, a general pool warning alarm indicating a disturbance at the pool and a fault alarm that indicate, respectively, a disturbance at the pool and a failure in the alarm system. Of course, the additional fault alarm is not entirely essential to the operation of the invention inasmuch as the alarm and test circuits both can be used to operate the pool warning alarm.

Thus there is provided in accordance with the invention a swimming pool alarm system that positively indicates a disturbance at an unattended pool and a fault in the alarm system, should such a failure develop.

For a more detailed understanding of the invention, attention is invited to the accompanying drawing and the following description.

BRIEF DESCRIPTION OF THE DRAWING

The sole figure of the drawing shows a schematic diagram of one embodiment of the invention for a swimming pool alarm system.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

An illustrative example of a typical embodiment of the invention is shown in the drawing. For instance, a swimming pool **10** is provided with an immersed hydrophone **11**. The hydrophone responds to sonic energy within the pool water **12** by sending electrical signals through an armored, waterproof cable **13** to an alarm system **14**. In this connection, it has been found that disturbances in the pool water **12** caused by a child falling in, or an attempt to damage the pool structure, invariably produces some sound waves of 5000 c.p.s. or less in the water.

Typically, in order to take advantage of this fact, the alarm system **14** comprises a switching system that includes an alarm circuit **15**, a test circuit **16**, a power supply **17**, and an oscillator **20**.

Signals in the cable **13** are coupled to a low-pass filter **21** that rejects or blocks all cable signals of frequencies greater than 5000 c.p.s. and passes on all signals of less than 5000 c.p.s. through a conductor **22** to a capacitor **23**. This low frequency signal is applied by the capacitor **23** through a voltage divider **24** to the base electrode of a PNP transistor **25**. The transistor **25** amplifies the low frequency signal and sends it from the transistor emitter electrode through a capacitor **26** to a variable potentiometer **27**.

An adjustable tap **28** on the potentiometer **27** is connected to the base of an NPN transistor **30**. The tap **28** is adjusted manually to set the sensitivity or threshold activation level of a transistor **30**. Thus, if the signal from the transistor **25** is of sufficient amplitude, the transistor **30** also is turned on. Lesser disturbances caused by wind, wave formation, and the like are thus rejected by the alarm circuit **15** and do not sound an alarm, as hereinafter described in more complete detail.

The collector electrode of the transistor **30** is coupled directly to the base of a PNP transistor **31**. When turned on, current in the collector of the transistor **30** provides sufficient base drive to activate the transistor **31**. A diode **32** and a relay **33** are connected in parallel to the emitter electrode of the transistor **31**. Activated transistor **31** energizes the relay **33** in order to operate make contacts **34** and **35** which complete the circuits, respectively, for a small lamp **36** in the alarm circuit **15** and a major alarm **37**. Consequently, the alarm circuit **15** executes switching functions in response to low frequency disturbances in the water **12** in order to sound the alarm **37** and energize the lamp **36**.

To turn off the alarm **37**, a spring-biased single-throw, double-pole reset switch **42** is operated manually to close make contacts **43** and ground the base of the transistor **30**. The grounded base deactivates the transistor **30** which then causes the transistor **31** to turn off and release the relay **33**. When the relay **33** is deenergized, the contacts **34** and **35**, controlled by the relay, disconnect the lamp **36** and the alarm **37**. As an additional measure, the switch **42** also operates break contacts in the collector electrode circuit of the transistor **30** to ensure that the transistor is deactivated when the reset switch **42** is operated.

Ordinarily, the alarm circuit **15** is situated close to the pool inasmuch as the armored cable **13** ought to be as short as possible in order to reduce hydrophone signal attenuation and thereby increase the over-all sensitivity of the system. The alarm **37**, however, may be situated at some great distance from the pool site, as, for example, in a building remote from the pool grounds, at a police station or the like. The location of the reset switch **42** with the alarm circuit **15** at the pool is particularly advantageous in this regard because it requires someone to visit the pool site in order to restore the system **14** to a nonalarm condition. This necessarily requires a supervisory attendant to visit the pool site in response to the alarm.

An additional feature of the invention is embodied in the oscillator **20** and the test circuit **16**. In this connection, the oscillator generates an electrical signal of more than 5000 c.p.s. This higher frequency signal is coupled to a sonic transducer **44** immersed in the pool water **12**. The transducer **44** generates sound waves **45** in the water that have a frequency greater than 5000 c.p.s. The sound waves **45** are registered by the previously described hydrophone **11**. These higher frequency signals are transmitted up the cable **13** as electrical signals where a high-pass filter **46** blocks the cable signals of less than 5000 c.p.s. and passes the higher frequency signals that were generated initially by the oscillator **20** to a capacitor **47** through an output conductor **50**.

These signals from the capacitor **47** are passed through a voltage divider **51** to the base electrode of a PNP transistor **52**. The base electrode signal causes the transistor **52** to conduct current. A variable potentiometer **53** in the collector circuit of the transistor **52** responds by coupling a base current through a manually adjustable tap **54** to the base of an NPN transistor **55**. The tap **54** on the potentiometer **53** also establishes the minimum activation signal or sensitivity level for the transistor **55**.

When normally activated, the transistor **55** energizes a relay **56** in the collector circuit. Thus, when energized in the foregoing manner, the relay **56** operates break contacts **57** in the alarm **37** to keep the alarm inactive and also operates break contacts **60** to keep a local fault light **61** inactive. Accordingly, the test circuit **16** performs switching functions in order to control the alarm **37** and the operation of the lamp **61**.

In operation, signals of more than 5000 c.p.s. generated initially by the oscillator **20** are passed by the filter **46** to the test circuit **16** and thereby keep the relay **56** energized to prevent the alarm **37** and the lamp **61** from sounding. During this time, however, the alarm circuit **15** normally is inactive because the low-pass filter **21** blocks the passage of this higher frequency signal.

A disturbance in the pool **10** generates signals of less than 5000 c.p.s. that are passed by the low-pass filter **21** to activate the alarm circuit **15** and thus energize the relay **33**. The relay **33** operates the make contacts **34** and **35** to complete the circuits for the lamp **36** and the alarm **37**, respectively.

If for some reason, the hydrophone **11** or cable **13** should be vandalized or accidentally damaged, the higher frequency oscilator signal **45** will be interrupted. In this situation, the fault circuit **16** will be deenergized and the relay **56** will release the break contacts **57** and **60** which then activate the alarm **37** and energize the fault light **61**, respectively. Also, a power failure or tampering with the system **14** will cause the spring-biased break contacts **57** and **60** to be released. In this circumstance, an attendant at a remote location will know that the alarm system **14**

is not functioning properly or that there may be a disturbance at the pool **10**. In any event, a personal visit must be made to the pool site to inspect the fault and alarm lights **61** and **36** and repair or reset the system.

Power is provided for these circuits through the supply **17** which comprises a source of **60** cycle alternating current **64**, a transformer **65**, and a voltage rectifier circuit **66** coupled to a secondary winding **67** of the transformer **65**.

We claim:

1. A swimming pool alarm system comprising an oscillator for generating a signal greater than 5000 c.p.s., a sonic transducer in the pool and coupled to said oscillator for converting said signal into sound pulses greater than 5000 c.p.s., a hydrophone in the pool for producing signals in response to sound pulses of less than 5000 c.p.s. and including said sonic transducer pulses, a first filter for passing said sonic transducer signals registered by said hydrophone, a PNP transistor coupled to said first filter for amplifying the first filter signals, a test relay, an NPN transistor coupled to said amplified first filter signal for energizing said test relay, an alarm deactivated when said test relay is energized, a second filter for passing other signals registered by said hydrophone, a PNP transistor coupled to said second filter for amplifying said second filter signals, an alarm relay, and NPN transistor coupled to said amplified second filter signals for energizing said alarm relay to activate said alarm in response to said other signals, and a fault alarm controlled by said test relay to indicate operative and inoperative system conditions.

2. A swimming pool alarm system comprising an oscillator for generating a signal greater than 5000 c.p.s., a sonic transducer in the pool and coupled to said oscillator for converting said signal into sound pulses greater than 5000 c.p.s., a hydrophone in the pool for producing signals in response to sound pulses of less than 5000 c.p.s. and including said sonic transducer pulses, a first semiconductor coupled to said hydrophone for amplifying the signals, a test relay, a second semiconductor coupled to said amplified signals for energizing said test relay, an alarm deactivated when said test relay is energized, a filter for passing signals registered by said hydrophone other than said sonic transducer sound pulses, a third semiconductor coupled to said filter for amplifying said filter signals, an alarm relay, a fourth semiconductor coupled to said amplified filter signals for energizing said alarm relay to activate said alarm in response to said other signals, and a fault alarm controlled by said test relay to indicate operative and inoperative system conditions.

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