United States Patent [19]
Jahn

[11] 3,778,803
[45] Dec. 11, 1973

[54] **SWIMMING POOL GUARD ALARM UNIT**

[75] Inventor: **Darrel S. Jahn**, Mountain View, Calif.

[73] Assignee: **Aquatic Systems, Inc.**, Sunnyvale, Calif.

[22] Filed: **Sept. 27, 1971**

[21] Appl. No.: **184,085**

[52] **U.S. Cl.** **340/261**, 200/230, 340/224
[51] **Int. Cl.** **G08b 13/00**
[58] **Field of Search** ..... 340/261, 258 R, 421, 340/244 B, 224; 200/61.2, 84 R, 230

[56] **References Cited**

UNITED STATES PATENTS

3,504,145	3/1970	Layher	200/84 R
2,816,973	12/1957	Beck et al.	340/244 B
3,636,544	1/1972	Codina	340/224
3,329,935	7/1967	Wiggins	340/261

Primary Examiner—John W. Caldwell
Assistant Examiner—Glen R. Swann, III
Attorney—Gerald P. Parsons et al.

[57] **ABSTRACT**

A device for monitoring wave action on the surface of water in a swimming pool in a manner to sound an alarm when someone either accidentally falls into a swimming pool or uses the pool without authorization. A buoy floats on the surface of the swimming pool for detecting excessive wave action. At least one position-sensitive switch is attached to a pivotably mounted float within the buoy for detecting such wave action. A signal from the switch in the buoy is transmitted to a remote alarm unit either by a direct wire connection or by a low power radio transmitter located within the buoy.

11 Claims, 8 Drawing Figures

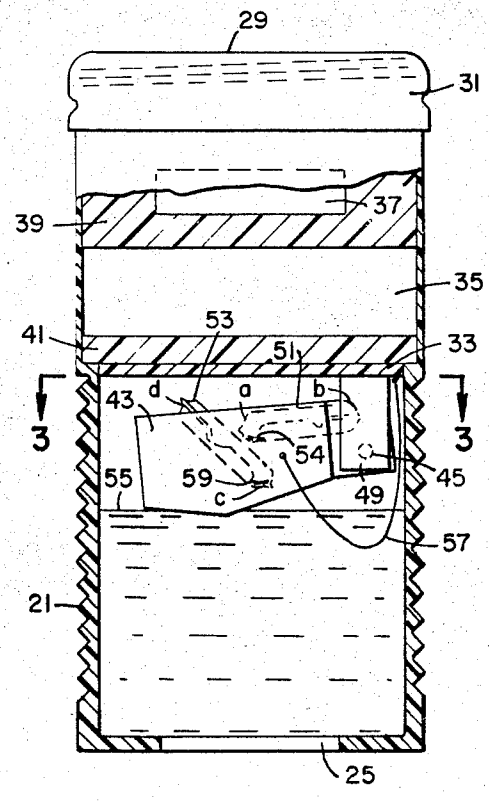


FIG_1

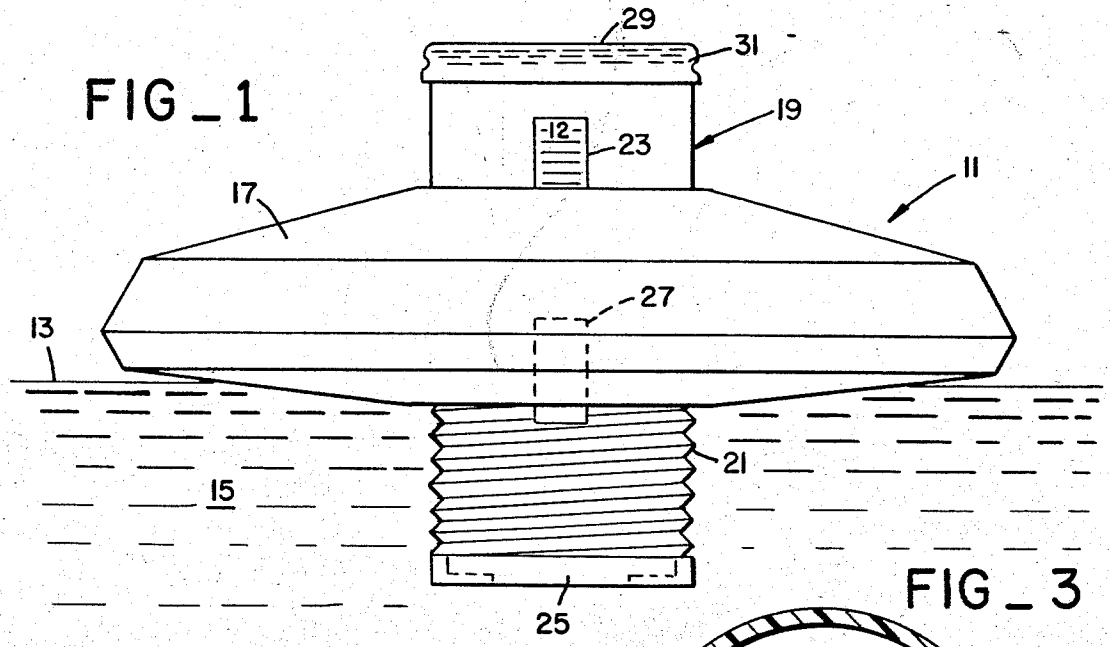
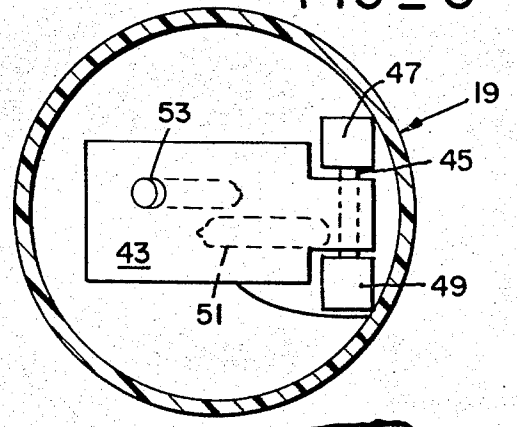


FIG_3



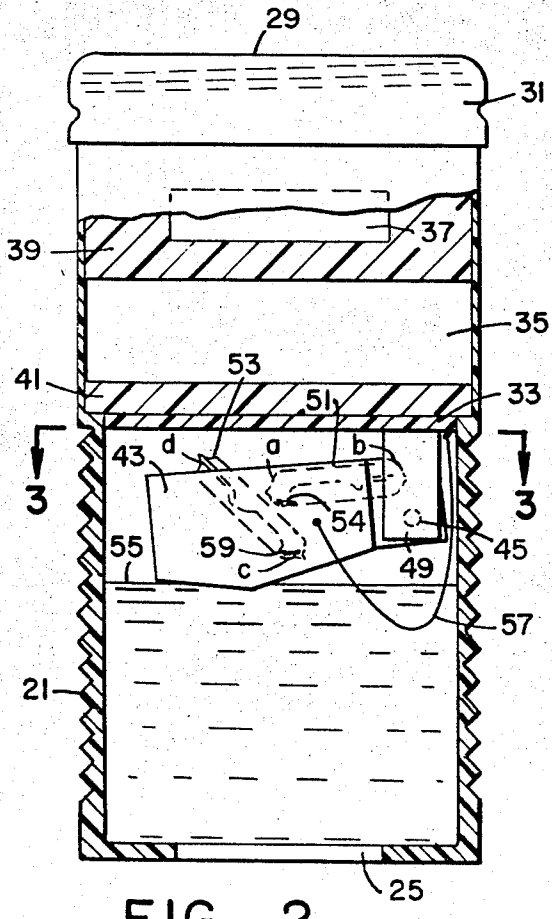


FIG_2

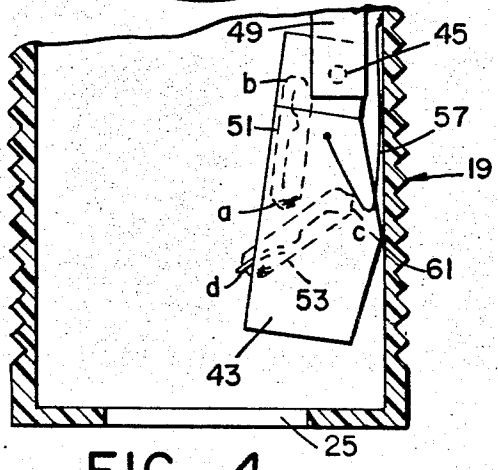


FIG_4

INVENTOR
DARREL S. JAHN

BY
Limbach, Limbach & Sutton

ATTORNEYS

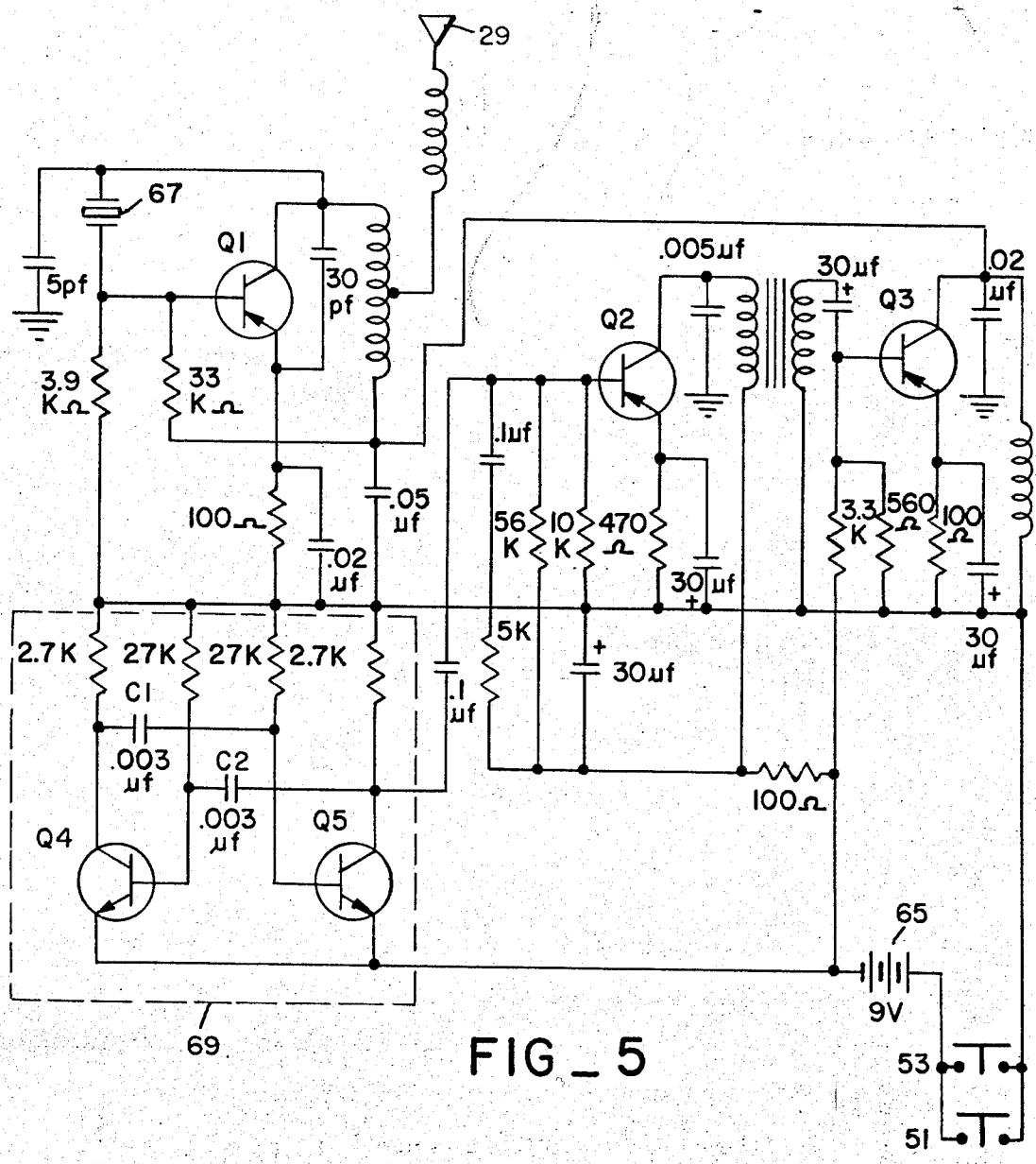


FIG_5

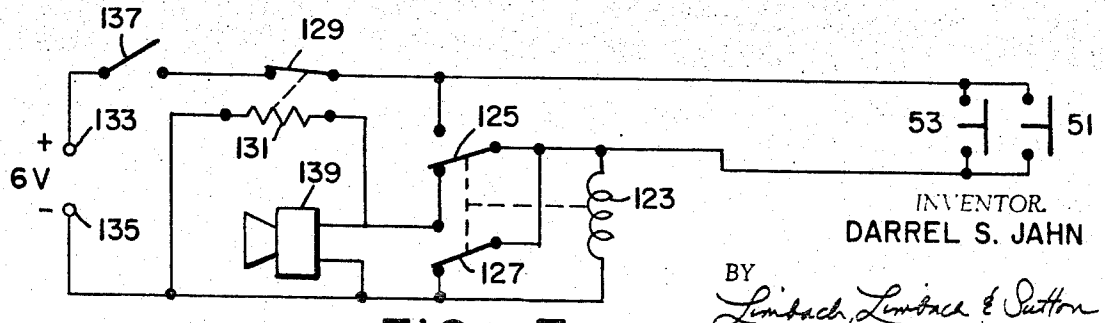
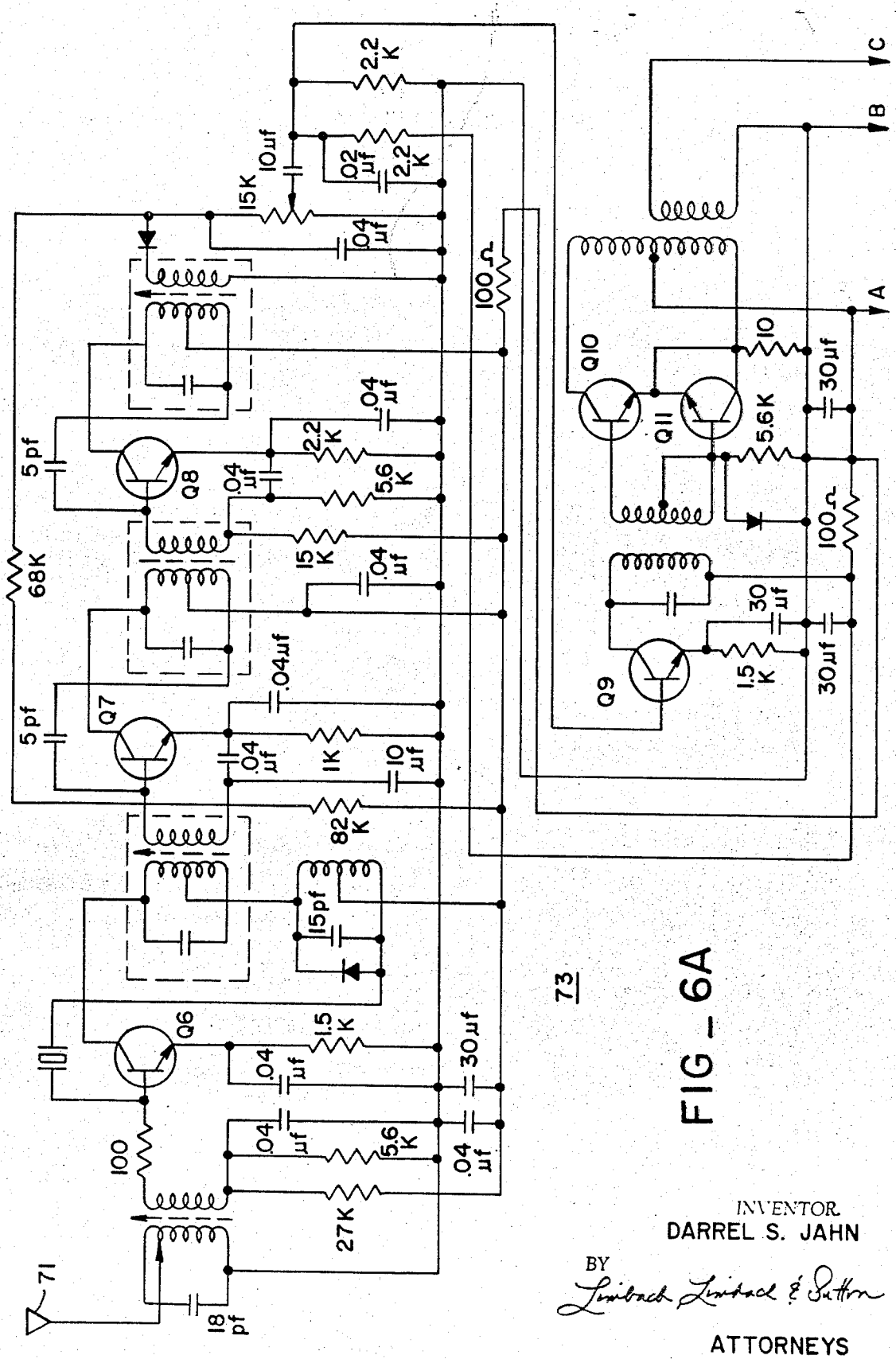


FIG_7

INVENTOR.
DARREL S. JAHN

BY Limbach, Limbach & Sutton

ATTORNEYS



73

FIG - 6A

INVENTOR.
DARREL S. JAHN

BY
Limbach Limbach & Sutton

ATTORNEYS

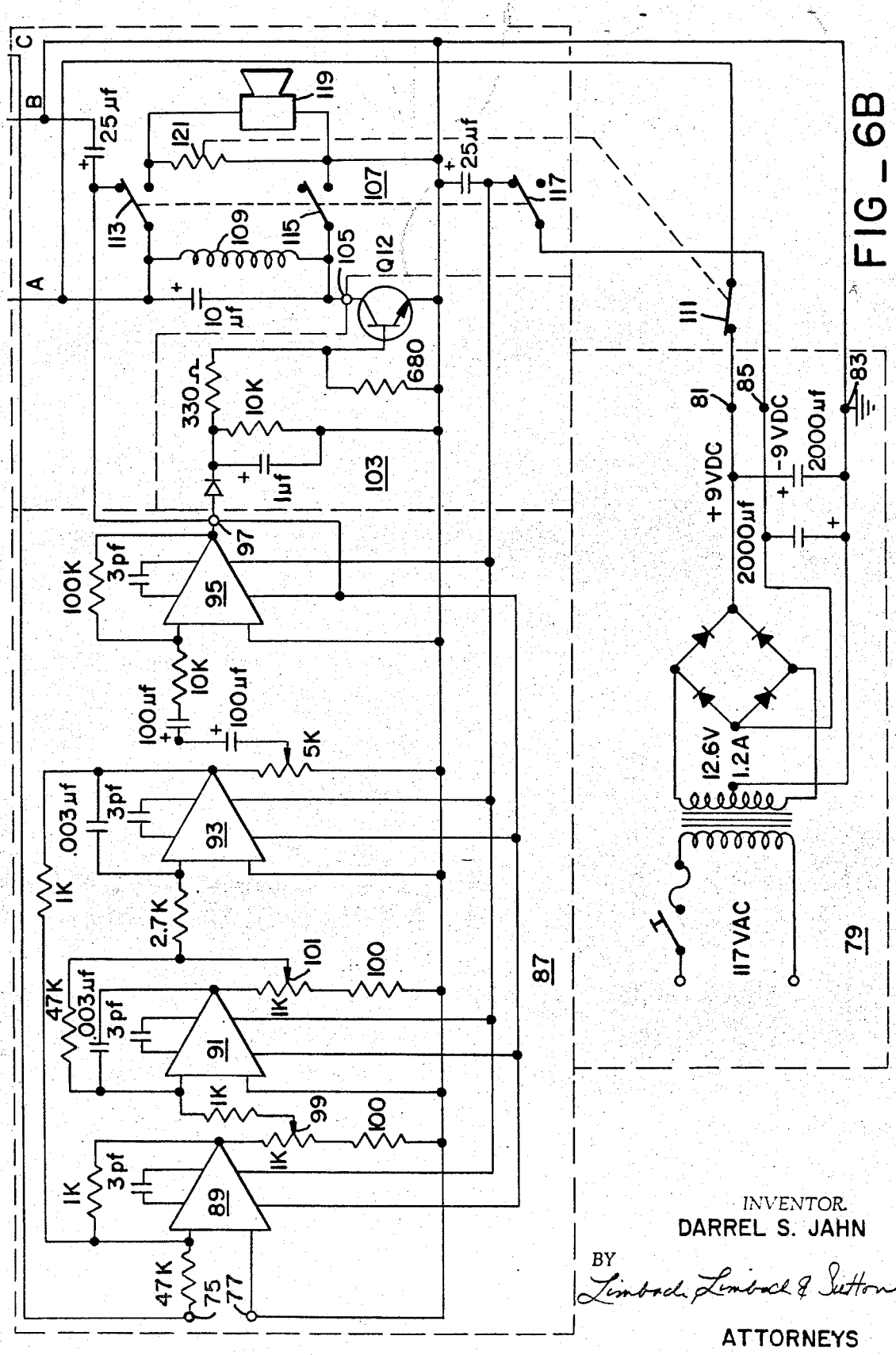


FIG_6B

INVENTOR.
DARREL S. JAHN

BY
Limbach Limbach & Sutton

ATTORNEYS

SWIMMING POOL GUARD ALARM UNIT

BACKGROUND OF THE INVENTION

This invention relates generally to the art of sensing wave motion on the surface of a body of liquid, and more specifically relates to such devices designed for use on the surface of a swimming pool for detecting use of the pool.

When a swimming pool is unattended and not in use, it is often desirable to have some means to detect when someone uses the pool. In the case of a private pool adjacent a house with young children, it is desirable to have a device which sounds an alarm in the house when a child first falls into the pool in order to alert an adult to effect a rescue as soon as possible. Additionally, it is often desirable to be able to monitor an unattended pool to detect an unauthorized person using the pool. There are several commercially available units for monitoring the use of a swimming pool, but these units suffer from certain disadvantages that are overcome by the monitoring device of the present invention.

In one such commercially available device, a sensor is held a few inches below the surface of the swimming pool water by anchoring an electrical control cord to the pool bottom. The control wire is then connected to an alarm unit in an adjoining house or other structure. A difficulty with this type of device is that it has to be removed before the pool may be used for swimming. This device is battery operated and sounds an alarm continuously until shut off manually, thereby running down the batteries if someone does not immediately hear the alarm. The device is ineffective until the dead battery is discovered. Additionally, this type of device may be disabled by an unauthorized person by first cutting the wire between the sensor in the pool and the alarm in the adjoining structure.

Another type of device that is commercially available is self-contained and floats on the surface of a pool. Gas under pressure is released when wave action reaches a threshold level. A horn on the device is then sounded. The pressurized gas is contained in a removable cannister that may be replaced after the unit has once sounded. The primary difficulty with this type of pool monitoring unit is that once it sounds and uses all the pressurized gas of a cannister installed therein, the unit is no longer effective. If the alarm is sounded while no one is within range of the pool to hear it, it will not be known that a new pressured gas cannister need be installed. Furthermore, such a device may be easily disabled and removed from the pool by someone desiring to use the pool without authorization.

Yet another type of pool monitoring unit utilizes a sound transducer installed along the bottom of a pool and is connected with a remote alarm unit by wires. The main difficulty with this type of monitoring device is that it may not always pick up surface noise such as that created by a child or an animal falling into the pool. The sound transducer is activated if a swimmer moves around but may not respond to a mere splash in the pool.

Therefore, it is an object of the present invention to provide a swimming pool monitoring device which can detect both a family pet or child falling into a pool as well as detecting unauthorized use of the pool.

It is another object of the present invention to provide a pool monitoring device which looks like some other commonly used pool accessory in order to discourage attempts by unauthorized persons to disable the device

It is yet another object of the present invention to provide a pool monitoring device which is difficult to disable without sounding an alarm.

It is still a further object of the present invention to provide a pool monitoring device that does not quickly consume its self-contained source of power to render the device inoperative without the knowledge of those using the device.

SUMMARY OF THE INVENTION

These and additional objects are accomplished by the pool monitoring device of the present invention which includes a buoy that floats on the surface of the pool and is designed to look like an ordinary pool chlorinator. A ring of flotation material supports a cylindrical container mounted in an upright position. A float is mounted in the container and carries at least one positional sensitive electrical switch. When surface wave action from a person falling, jumping or diving into the pool disturbs the float, the electrical switch is activated which sets off an alarm in a remote unit. The float is preferably pivotably attached to the interior of the container. When there is excessive wave action in the pool, the float is rotated about its pivot into a position that is different from the normal position. The entire container is made adjustable with respect to the ring of flotation material (and thus with respect to the pool water surface) in order to adjust the sensitivity of the device so that normal waves generated by the wind will not tilt the float enough to change the state of the switch.

In order to also detect when the device is withdrawn from the swimming pool by an unauthorized person, a second positional-sensitive switch is carried by the pivotably mounted float. The second switch is in a different position on the float from the first switch. In a specific preferred embodiment, the float is normally held slightly below a horizontal position by the water level of the swimming pool when the container is properly adjusted on the ring of flotation material. The first switch is oriented to change its state when the float is caused to rise by wave action. The second switch is oriented on the float to change its state when the float falls to a substantially vertical position. Having two switches makes it extremely difficult for an intruder to withdraw the buoy from the swimming pool without changing the state of one of the switches which activates a remote alarm.

A change of state of either of the switches located in the bouy is transmitted to a remote alarm unit either by wire or by the use of a radio frequency transmitter within the bouy. Use of a radio frequency transmitter rather than a wire connection has an advantage of providing greater flexibility in remote positioning of the alarm unit. The alarm unit may even be moved to a neighbor's house for monitoring of the pool when the pool owner is away for an extended period. In either of the radio transmitter or wire connection embodiments, the switches within the buoy are normally in an "off" state. When either of the switches is closed (turned to its "on" state), an audio alarm begins to sound. The alarm continues to sound even though the buoy switch is only on for an instant. A time delay circuit within the alarm unit allows the audio alarm to sound only for an adjusted predetermined period of time.

In the radio transmitter embodiment, a small battery operated transmitter is installed within the cylindrical container of the buoy. The transmitter is operative only during the period of time that either one of the two position sensitive switches is closed. The frequency of operation of the transmitter is chosen to be within a band permitted for unlicensed low power transmitters by existing F.C.C. regulations. As part of the transmitter, the radio requency signal is modulated by a constant frequency audio oscillator but just outside of the normal audio frequency range. The remote alarm unit contains a receiver for receiving the radio frequency signal and demodulating it. A highly selective filter unit is made as part of the receiver so that the alarm is activated only when buoy transmitter modulating frequency is received. In making the modulating frequency something outside the audio range, the chances that the alarm of the receiver will be set off by voice operation of a transceiver on the same radio frequency as the buoy transmitter is substantially eliminated.

Further objects and advantages of the present invention will become apparent from the description which follows when taken in conjunction with the drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a side view of a buoy containing a radio frequency transmitter according to one aspect of the present invention;

FIG. 2 is a partially cut away view of a container portion of the buoy of FIG. 1;

FIG. 3 is a sectional view of the container of FIG. 2 taken across section 3—3;

FIG. 4 is a partial view of the broken away container of FIG. 2 under different conditions;

FIG. 5 is a circuit diagram of radio transmitter for insertion in the buoy of FIG. 1;

FIGS. 6A and 6B show a radio receiver and alarm circuit diagram for the remote alarm unit; and

FIG. 7 shows a circuit diagram for an alarm unit that is connected by wire to a buoy, according to another aspect of the present invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

FIG. 1 shows a buoy 11 floating on a surface 13 of swimming pool water 15. The buoy 11 includes two principal components. A volume of flotation material 17 is formed in the shape of a ring with a circular opening in its center for receiving a cylindrical container 19. These two components may be essentially the same as corresponding components of existing floating swimming pool chlorinators which are designed and sold for floating on the surface of swimming pools to dispense chlorine at a constant slow rate. The buoy 11, of course, does not serve a function of chlorinating a swimming pool but its overall appearance as a pool chlorinator conceals its true function to an intruder who may attempt to disable an obvious alarm unit before using the pool.

The float 17 is preferably made of a light plastic foam material. The container 19 is in the shape of an elongated cylinder and is preferably made of a thin water-tight plastic material. A single thread extending outward from the inner surface of the center hold of the float ring 17, not shown, supports the container 19 somewhere along its external surface threads 21. The elevation of the container 19 with respect to the float 17, and thus the elevation of the container 19 with respect to the water surface 13, may be adjusted by rotating the container 19 with respect to the float 17. A scale 23 formed on the surface on the container 19 indicates its elevation with respect to the float 17. An opening 25 is provided in the bottom of the container 19 for water to pass into the container. Additionally, an opening 27 is provided on the side of the container 19 in order to open the volume inside the container and above the water level to atomspheric air pressure. A flattened space, not shown, on the side of the container 19 extending beneath the scale 23 provides an air passage to the opening 27 from the region above the float 17. A disturbance on the surface 13 of the swimming pool is reflected into the container 19 in the form of a surface disturbance of the water therein. It is the disturbance of the water level within the container 19 that is detected by the buoy 11. When this disturbance is greater than a threshold amount, a radio transmitter within the container 19 is operated to emit a radio frequency signal from a wire antenna 29 attached to the inner surface of a cap 31. The cap 31 is affixed to the container 19 in a water-tight manner.

Referring to FIG. 2, an enlarged partially broken away view of the cylindrical container 19 is illustrated. A rigid plastic disc 33 forms a water-tight compartment at the upper end of the container 19 for housing a transmitter and its battery in cavities 35 and 37, respectively. The cavities 35 and 37 are formed by heat and shock-absorbing plastic foam pieces 39 and 41.

Below the rigid disc 33 is the region of the container 19 which receives swimming pool water. A block of lightweight plastic material is formed into the shape of a float 43. A rigid plastic rod 45 is attached to the float 43 and is pivotably mounted in rigid plastic blocks 47 and 49 at either end of the rod 45. The blocks 47 and 49 are firmly attached to the underside of the disc 33. Position sensitive switches 51 and 53 are embedded within the float 43 by cutting holes in the float, inserting the switches therein and then sealing the switches with a silicon rubber fluid which forms a water-tight seal. The pivotable position of the float 43 is controlled by the height of the liquid surface 55 within the container 19. The electrical switches 51 and 53 thereby sense the level of the swimming pool surface as reflected within the container 19.

The switches 51 and 53 are preferably of the type wherein an elongated generally cylindrically shaped glass tube is filled with a small amount of electrically conducting liquid such as mercury. A pair of conductors within each tube are normally spaced apart and insulated until the switch is oriented in a position to cause the mercury to flow and join the two electrodes in a complete electrical circuit. In the position of the float 43 shown in FIG. 2, a pool of mercury 54 rests at an end *a* within the glass tube of the switch 51. Since the pair of electrodes are at the end *b* of the switch 51, no electrical connection is made and the switch is in an "off" state. As wave action on the swimming pool surface increases above some threshold level, the level of the liquid surface 55 within the container 19 will raise the float 43 into a horizontal position or above, thus causing the mercury pool 54 to flow toward the end *b* within the switch 51 and thus made an electrical connection between its bare pair of electrodes. The switch 51 is then in its "on" state. The sensitivity of the switch 51 is adjusted by raising or lowering the container 19

with respect to the float 17, thus determining the magnitude of wave action necessary to operate the switch 51.

The internal electrodes of the switch 51 are connected by a flexible wire pair 57 to the transmitter, in a manner discussed hereinafter, to transmit an alarm signal to a remote alarm unit. The switch 51 need be changed from its normal "off" state to its "on" state only for an instant to cause a pulse of radio frequency to be emitted by the antenna 29 and cause an alarm to be sounded in a remote location. Therefore, a single wave of a sufficient amplitude will operate a remote alarm.

The second switch 53 is connected electrically in parallel with the switch 51 and to the pair of conductors 57 so that the transmitter emits a signal when either of the switches are caused to be thrown into their "on" state. The switch 53 has a pool of mercury 59 at its end *c* when the float 43 is in the position shown in FIG. 2. No electrical connection is made in this position between a pair of conductors within the switch 53. However if the buoy 11 is removed from the water by someone attempting to disable the device, the float 43 falls to a position shown in FIG. 4. The switch 51 remains in its "off" state but the switch 53 is oriented in FIG. 4 so that its mercury pool has travelled to the end *d* of the switch, thus making contact between the two electrodes of the switch 53. The pair of wires 57 are then connected together. The radio frequency transmitter thus emits a signal which sounds an alarm in a remote alarm unit.

The float 43 is shaped to have a point 61 extending from its bottom side for contacting a side wall of the container 19 as shown in FIG. 4 when the buoy is withdrawn from the swimming pool water. The reason for the extension 61 is to hold the center of gravity of the float 43 at a position that is to the left of the pivot rod 45 when the float is in the position shown in FIG. 4. When buoy 11 is put back into the water, therefore, water rushing in through the opening 25 at the bottom of the container 19 will not hold the float 43 in the position shown in FIG. 4 but rather will cause it to pivot clockwise with its position determined by the resulting level of the water within the container 19.

The swimming pool owner probably desires to remove the buoy 11 while the pool is being used with his authority or when being cleaned in order to prevent repetitive pulses from being emitted from the radio transmitter. Continued operation of the transmitter can run down its battery. In order to prevent the float 43 from falling to the position shown in FIG. 4, where the switch 53 will keep the transmitter on, a volume of deformable plastic (not shown) is provided for insertion through the opening 25. Such a volume of plastic is designed to hold the float 43 at less than horizontal to prevent operation of the switch 51. This technique does not avoid operation of the remote alarm since it is difficult to insert a plastic block without setting off at least one transmitter pulse.

A detailed circuit diagram of the radio frequency transmitter for installation in the container 19 is shown in FIG. 5. An electrical representation of the switches 51 and 53 that are mounted on the float 43 is included in FIG. 5. These switches are electrically in parallel, and the pair of switches is in series with a battery power source 65. Only when one of the switches 51 or 53, or both, are closed will the transmitter represented in FIG. 5 emit a radio frequency signal from the antenna 29. A crystal 67 controls the frequency of oscillation of radio frequency oscillator circuit which includes the transistor Q_1. The transmitter of FIG. 5 operates in the 27 megacycle range so the crystal 67 is chosen for a particular frequency in this range.

An audio oscillator circuit 69, including transistors Q_4 and Q_5, modulates the radio frequency signal that is generated by the radio frequency oscillator. The circuit 69 as shown in FIG. 5 has particular circuit components for oscillation in the area of 30,000 cycles per second. The frequency of oscillation of the oscillator 69 is chosen to be outside of the normal voice audio range so as to develop a signal from the antenna 29 that is unique and can be distinguished from signals developed by other low power transmitters that operate in the 27 megacycle range. The exact frequency of the oscillator 69 can be varied by changing both of the capacitors C_1 and C_2 from the values shown in FIG. 5 to some other specific value. C_1 and C_2 are kept at substantially the same value.

Te particular circuit diagram of FIG. 5 is a modified commercially available super-regenerative transceiver. The commercially available transciver may be wired permanently to operate in the transmit mode and it voice circuits are replaced by the single frequency oscillator circuit 69. Of course, there is a wide variety of different types of miniature low power transmitters that may be utilized as part of the present invention.

A preferred receiver for receiving the signal transmitted by the transmitter of FIG. 5 at a location remote from the buoy is illustrated in the form of a detailed electronic circuit diagram in FIG. 6A and 6B. Such a receiver and alarm circuit can be mounted in a small box within a home adjacent the pool in which the buoy is floating for monitoring its use while unattended. The radio frequency signal is received at the receiver antenna 71 of FIG. 6A and an audio signal is demodulated therefrom by a receiver section enclosed by the dotted lines and indicated by the reference number 73. The audio signal being demodulated from the radio frequency signal received is presented at terminals 75 and 77. The receiver section 73 of the FIG. 6A circuit is again one that is commercially available, as part of a superheterodyne transceiver circuit. The commercially available transceiver is modified to operate permanently in its receiving mode, and additional components of the transceiver dealing with other functions than merely demodulating a radio frequency signal to obtain an audio signal therefrom are not used.

A power supply circuit 79 is provided for developing the required positive DC voltage at a terminal 81 with respect to a neutral terminal 83. Also, the power supply circuit 79 develops a negative direct current voltage at a terminal 85, with respect to the neutral terminal 83. Although the circuit of FIGS. 6A and 6B could be operated by batteries, it is felt preferable to use ordinary house current. Since current is consumed by the circuit of FIGS. 6A and 6B throughout the period that the pool is being monitored, the use of batteries and the inconvenience of having to replace them at periodic intervals is avoided.

The demodulated audio signal at terminals 75 and 77 is operated upon by an electronic filter section of the circuit of FIG. 6B indicated at 87. The filter unit 87 includes the use of four operational amplifiers 89, 91, 93, and 95, all connected in series. The filter unit 87 is a

highly selective filter which presents a voltage at its output terminal **97** only when the input signal is very close to the center frequency to which the filter unit **87** is tuned.

The first three operational amplifiers **89, 91,** and **93** of the filter section **87** of the FIG. 6B circuit comprise the actual filter while the last operational amplifier **95** serves to provide voltage amplification. To adjust the filter circuit **87,** a modulated signal is transmitted to the receiver of the circuit of FIG. **6A.** The potentiometers **99** and **101** are then adjusted for a peak voltage output at the terminal **97.** The receiver is then adjusted for its mating buoy transmitter. The filter **97** is narrowly tuned to the audio range modulating signal developed by audio oscillator **69** of FIG. **5.** The operational amplifiers **89, 91, 93,** and **95** of FIG. **6B** may be an appropriate commercially available version such as a Fairchild No. 748 operational amplifier or its equivalent.

The voltage level at the terminal **97** is normally substantially zero except when a radio frequency signal is received at the antenna **71** which has been modulated by the audio range frequency to which the filter section has been tuned. When such a signal is received, the voltage at the terminal **97** jumps to a maximum value. However, the current available at the output terminal **97** is not sufficient for driving a relay and time delay tube. Therefore, a current driving circuit **103** is connected to the output of the filter circuit **87** and includes a transistor Q_{12} which acts as a power amplifier. An output terminal **105** of the current driving circuit **103** is connected with a signal circuit **107.**

A relay coil **109** is connected between the output terminal **105** of the driving circuit **103** and to the positive DC supply developed at power supply output terminal **81** in series with a normally closed circuit breaker **111.** The circuit breaker **111** is part of a delay tube to be described below. The relay includes switches **113, 115,** and **117** which are normally held in positions shown in FIG. **6B** absent a current being applied to the relay coil **109** of sufficient magnitude to move the switches to their alternate positions.

When in the rest position shown in FIG. **6B,** the power supply circuit **79** is connected with the filter circuit **87** through the relay switches. The relay switch **113** normally connects the positive direct current voltage from the power supply **79** to the filter circuit **87.** The relay switch **117** normally connects the negative direct current voltage to the filter circuit. When a signal is received that moves these relay switches to their second positions, however, both the positive and negative direct current voltage are disconnected from the filter circuit in order to prevent any spurious signals from being generated At the same time, the relay switch **115** connects to ground the terminal of the relay coil **109** that is continually connected with the driver output terminal **105.** This keeps the relay coil **109** energized and even though after the first instant there may no longer be a signal at the terminal **105** that will drive the relay coil **109.** This keeps the relay switches **113, 115** and **117** in their second position alternate from that shown in FIG. **6B.** By so locking the relay, an alarm may be sounded for a period of time greater than the radio frequency signal is transmitted by the swimming pool buoy. The advantage of this is that it only takes the pulse of the properly modulated radio frequency signal to cause an alarm to sound for a predetermined period that is independent of the length of this radio frequency pulse.

When the relay coil **109** is energized, the switches **113** and **115** connect the positive direct current and ground, respectively, across an audio horn **119.** Connected parallel with the horn **119,** and thus also across the positive direct current source, is a heating element of a commercially available delay tube, indicated by the resistance **121.** When the heating element **121** has been connected across the positive direct current source for a time sufficient to reach a predetermined level, the circuit breaker **111** is thrown, which disconnects the entire circuit from the positive direct current output terminal **81.** At this point, the relay coil **109** is also disenergized and the switches **113, 115** and **117** are returned to their rest position shown in FIG. **6B.** The sounding of the horn is then discontinued and the resistance element **121** of the delay tub is disenergized. When the resistance element **121** cools sufficiently, the circuit breaker **111** automatically returns to complete the positive direct current circuit to supply the remaining portion of the receiver and alarm circuit. The receiver is then ready to detect the next radio frequency signal from the buoy.

The particular type of delay tube of which the resistance element **121** and the circuit breaker **111** are a part is chosen for the length of time the horn **119** is desired to sound when a large wave on the surface of the swimming pool strikes the buoy. If a short time is required, a commercially available **6C5** delay tube may be used for about a 5-second horn blast. If about a 30-second sounding of the horn is desired, a **6C30** delay tube may be used.

The transmitter and receiver circuits of FIGS. **5** and **6A** and **6B,** respectively, have the advantage that several buoys may be employed in several swimming pools and monitored by a single receiver/alarm unit. The audio oscillator **69** (FIG. **5**) of each buoy is tuned to a unique frequency by having the capacitors C_1 and C_2 fixed at a unique value for each buoy. The receiver circuit of FIG. **6B** is then modified to include a plurality of filters **87** in parallel, one filter tuned to the audio oscillator frequency of each buoy.

For reasons primarily of economy, some users may prefer a direct wire connection between the positional sensitive switches of the buoy and an alarm unit rather than the radio frequency connection described above. In such a case, of course, the transmitter and battery are omitted from the container **19** of the buoy **11** of FIG. **1,** and one end of a long wire is connected with the switches **51** and **53.** The alarm unit installed in an adjoining structure is connected to the other end of the long wire and is greatly simplified from the receiver/alarm unit of FIGS. **6A** and **6B.** FIG. **7** shows a preferred circuit for the alarm unit which is connected by wire to the switches **51** and **53** of the buoy. A double-pole, double-throw relay is used having a coil **123** and switches **125** and **127.** The switches **125** and **127** are shown in FIG. **7** in their rest position when the relay coil **123** is not energized, and it will be noted that in this state no electrical connection is made by the relay switches.

A circuit breaker **129** is part of the delay tube which also includes a heating element denoted by the resistance **131,** similar to the signal circuit **107** of FIG. **6B.** A low direct current voltage source, preferably from a battery, may be connected across terminals **133** and

135. A master on-off switch 137 is connected to the positive voltage source terminal 133. A battery may be used in this case since the circuit is operative only for a short time after either of the buoy switches 51 and 53 is momentarily closed. A horn 139 sounds an alarm when one of the switches of the buoy is instantaneously closed.

The principle of operation of the circuit of FIG. 7 is similar to that of the signal circuit 107 of the more complicated receiver/alarm unit of FIGS. 6A and 6B. When the on-off switch 137 is closed, the relay coil 123 is connected across the voltage terminals 133 and 135 when either of the switches 51 and 53 in the buoy are closed for an instant. When this occurs, the switches 125 and 127 of the relay are moved to the alternate position from that shown in FIG. 7. The switch 125 then connects the relay coil 133 across the power input terminals 133 and 135 to lock the relay after the switches 51 and 53 both become open again. After the relay is so thrown, the horn 133 sounds and the heating element 131 of the delay tube is connected across the voltage input terminals 133 and 135.

This circuit state occurs until the heating element 131 of the delay tube gets hot enough to throw the circuit breaker 129 of the delay tube. When the circuit breaker 129 is thrown, the input voltage across terminals 133 and 135 is disconnected from all of the circuit elements, including the relay coil 123, the horn 139 and the heating element 131 of the delay tube. The horn then stops blowing, the relay switches 125 and 127 return to their rest position shown in FIG. 7, and the heating element 131 of the delay tube begins to cool. When the heating element 131 is cooled sufficiently, the circuit breaker 129 returns to its position shown in FIG. 7 to connect all of the elements to the voltage input supply. The circuit is now ready for another pulse by momentary closing of either of the switches 51 and 53. It will be noted that the direct wire connected embodiment of the alarm system of the present invention as shown in FIG. 7 also has the advantage that the length of time that the horn 139 is sounded is independent of the length of time that one of the switches of the buoy is closed. The length of the horn blast may be set by choice of the delay tube.

The present invention has been described in its preferred specific embodiments and it will be understood that the full scope of the invention is defined by the appended claims.

What is claimed is:

1. Apparatus for monitoring surface waves on a body of liquid, comprising

a piece of flotation material for supporting the apparatus on the liquid surface,

a container supported by said flotation material in a manner to be partially submersed below the liquid surface, said container having an opening in the vacinity of its bottom for liquid to pass therethrough into said container and an air opening in the vacinity of its top, thereby allowing liquid to rise within the container to a level proportional to the height of the liquid surface surrounding said flotation material,

a float pivotably mounted within said container, the angular position of said float being controlled by the level of liquid within the container,

a first position sensitive electrical switch carried by said pivotably mounted float in a manner to have one electrical state when liquid is below a predetermined level within the container and a second electrical state when liquid is above said predetermined level,

means electrically connected with said switch for communicating its state to a remote location, whereby waves on the surface of the liquid cause said pivotably mounted float to change its angular position relative to said container and signals said positional change to said remote location, and

a second two-state position sensitive switch carried by said pivotably mounted float and oriented generally to be in one of its states when liquid is near said predetermined level within said container and in another of its states when the float is not supported against gravity within the container.

2. A swimming pool alarm unit, comprising:

a volume of material for floating on the surface of the swimming pool, said volume of material formed in the shape of a ring having a circular opening in its center,

a tubular container positioned within the opening of said ring and threadedly engaged therewith in a manner that the container may be moved up and down relative to the ring by twisting said container with respect to the ring,

said container including a water inlet opening in the vacinity of its bottom and an air opening in the vacinity of its top, thereby allowing water to rise within the container to a level porportional to the water surface level surrounding said ring of flotation material,

at least one position sensitive electrical switch within said container positioned to detect the water level within said container, and

means electrically connected with said switch for communicating its state to a remote location.

3. Apparatus for monitoring surface waves on a body of liquid, comprising:

a piece of flotation material for supporting the apparatus on the liquid surface,

a float pivotably mounted with respect to said flotation material in a manner to be supported against gravity by the liquid surface, said float including a block of plastic material with a pivot rod extending through one end thereof for supporting the float with respect to said flotation material in a manner to be rotatable with respect thereto,

at least one position sensitive electrical switch embedded in said pivotably mounted float in a manner to have one electrical state when the liquid surface is calm and a second electrical state when a liquid surface wave of sufficient magnitude strikes the flotation material, and

means electrically connected with said at least one switch for communicating its state to a remote location, whereby waves on the surface of the liquid cause said pivotably mounted float to change its angular position relative to said container and signals said positional change to said remote location.

4. An alarm system according to claim 3 wherein the single frequency of the transmitter audio oscillator is outside of the normal voice frequency range range.

5. An alarm system according to claim 3 wherein said means for sounding an audio alarm includes a switch means operable in response to a momentary signal output from said filter to connect an audio sounding de-

vice and a delay tube to a power source for a predetermined period, said delay tube being connected in a manner to disconnect said power source from the audio sounding device and the delay tube after a period of time determined by the characteristics of the delay tube.

6. Apparatus according to claim 4 wherein said radio frequency transmitter includes a single-frequency audio oscillator connected to modulate said transmitter signal, and further wherein said receiver includes a filter circuit tuned to the single frequency of the audio oscillator to enable said indication means when the received signal includes the modulating single frequency.

7. Apparatus according to claim 3 wherein said means for communicating the state of said at least one switch to remote location includes:

a radio frequency transmitter carried by said flotation material and connected with said at least one position sensitive switch in order to transmit a signal when said at least one switch is in its said second state, and

a radio frequency receiver located in a position remote from said flotation device and tuned to receive said radio frequency signal, said receiver includes means for giving an indication upon receipt of said signal.

8. Apparatus according to claim 4 wherein said indication means contains an alarm means for sounding an audio alarm for a predetermined time after first receiving the radio frequency signal, whereby a mere pulse of radio frequency energy will sound an alarm of said receiver for said predetermined time.

9. Apparatus according to claim 6 wherein said means for communicating the state of said at least one switch to a remote location includes:

a length of wire electrically connected with said switch and extending from said flotation material to said remote location, and

a signaling device located at said remote location and connected with said switch by said length of wire, said signaling device being operated when said at least one switch is in its second state.

10. Apparatus according to claim 9 wherein said signaling device includes an audio alarm that sounds for a predetermined time independent of the length of time that said at least one switch is in its second state.

11. Apparatus according to claim 6 wherein said float is shaped and supported in a manner to have its center of gravity displaced a distance away from a vertical projection of said pivot rod when the apparatus is removed from the liquid, thereby to prevent the float from being locked in a non-operating position when the apparatus is replaced in the liquid.

* * * * *