



(22) Date de dépôt/Filing Date: 1999/12/16

(41) Mise à la disp. pub./Open to Public Insp.: 2001/06/16

(45) Date de délivrance/Issue Date: 2006/04/25

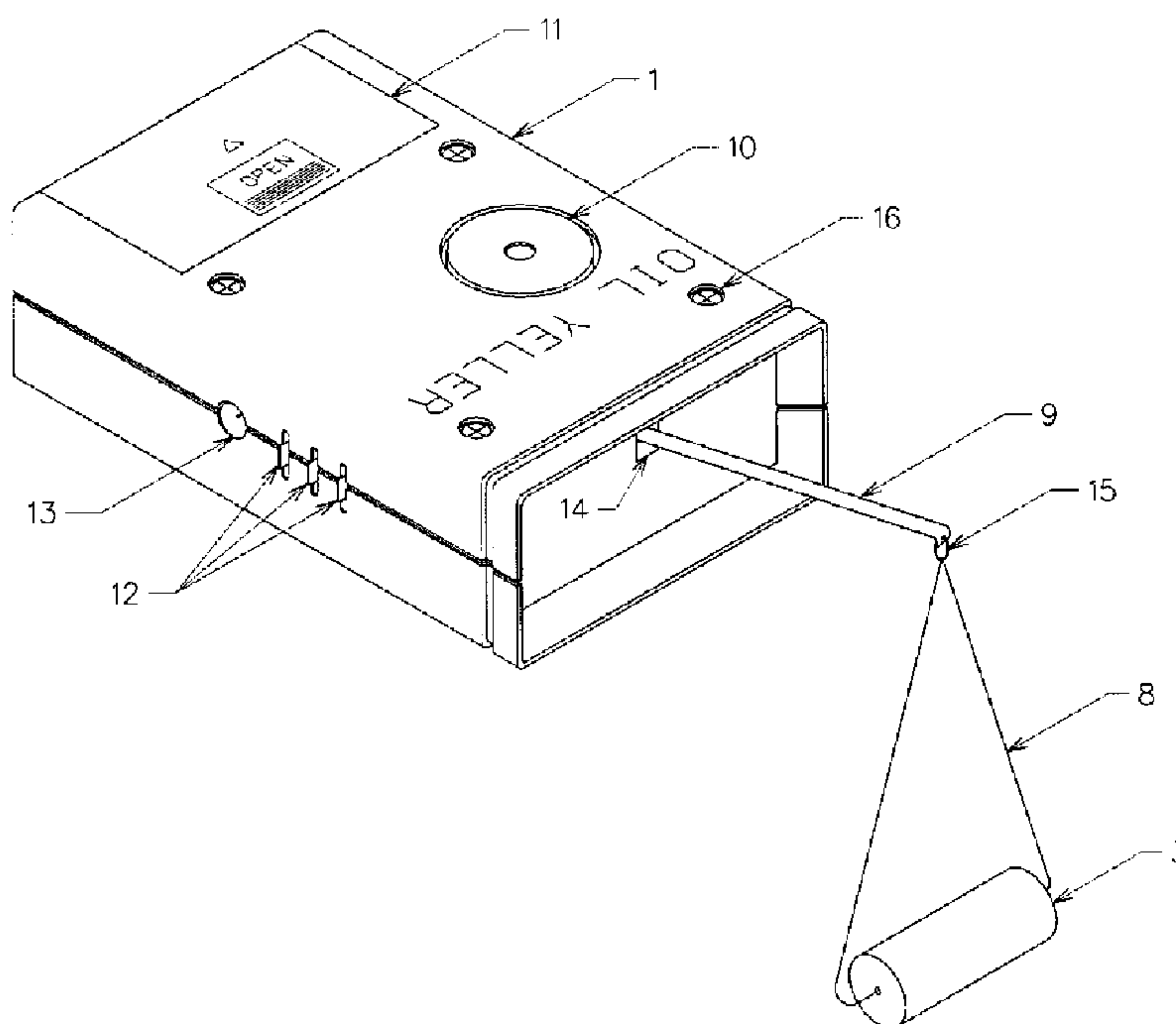
(51) Cl.Int./Int.Cl. *G01F 23/30* (2006.01),
G01F 25/00 (2006.01), *G01F 23/36* (2006.01),
G08B 21/20 (2006.01)

(72) Inventeurs/Inventors:
FREILL, MICHAEL R. G., CA;
FREILL, PETER E., CA

(73) Propriétaires/Owners:
FREILL, MICHAEL R. G., CA;
FREILL, PETER E., CA

(54) Titre : SYSTÈME D'ALARME/DETECTEUR DE FUITES DE PETROLE OU D'EAU

(54) Title: OIL OR WATER LEAK DETECTOR/ALARM SYSTEM



(57) **Abrégé/Abstract:**

The alarm system is capable of detecting both conductive and non conductive liquid level increases, designed for indoor operation, and ideally suited for detecting basement flooding or leaky domestic steel oil tanks or other fluid containment devices. A float, positioned above any surface such as a contained area (sump or drip pan), rises with the presence of a liquid, allowing a spring loaded switch to rise, triggering a 9-volt powered battery electric circuit. The electric circuit, enclosed in a plastic enclosure, activates an audible pulsating alarm when triggered. A battery voltage monitor incorporated in the electric circuit, tests the battery voltage on a continuous bases, and will trigger the unit into the alarm mode when the battery voltage is insufficient to sustain continuous operation. A simple convenient self check feature allows the user to simply check the unit, at anytime. An external connection is provided to allow the unit to be connected to a home security system or other external device to allow extended protection or secondary operations.



Abstract

The alarm system is capable of detecting both conductive and non conductive liquid level increases, designed for indoor operation, and ideally suited for detecting basement flooding or leaky domestic steel oil tanks or other fluid containment devices. A float, positioned above any surface such as a contained area (sump or drip pan), rises with the presence of a liquid, allowing a spring loaded switch to rise, triggering a 9- volt powered battery electric circuit . The electric circuit, enclosed in a plastic enclosure, activates an audible pulsating alarm when triggered. A battery voltage monitor incorporated in the electric circuit, tests the battery voltage on a continuous bases, and will trigger the unit into the alarm mode when the battery voltage is insufficient to sustain continuous operation. A simple convenient self check feature allows the user to simply check the unit, at anytime. An external connection is provided to allow the unit to be connected to a home security system or other external device to allow extended protection or secondary operations.

Background of the Invention

Field of the invention

The present invention relates to a liquid detection and alarm system for detecting the presence of oil or water leaks from indoor domestic appliances, basement flooding, or domestic furnace oil tanks. The invention may also be used for industrial application where the detection of leaking liquids are desirable to prevent environmental or other unwanted results. The invention is typically placed over a drip pan or low point of a surface where the liquid is likely to collect. This invention utilizes an electrical circuit with an audible alarm device, enclosed in housing with an attached float.

Background of the Invention and Previous Known Devices

Oil leaks from domestic 909 litre steel oil tanks or connections can cause serious damage to a home and create an environmental disaster if the oil finds its way under the building foundation. In most cases the oil must be reclaimed from the soil at a considerable expense. If the ground water becomes contaminated, cost for the clean up is higher, and in most cases the property is devalued. There is no accurate prediction device or method, which will determine with accuracy when a tank will fail, or when fittings will leak. There is a need for an alarm system, which will be reliable, compact, and will warn the residents that their oil tank is leaking.

The invention will operate for liquids with a density greater than 775 kg/m³ and have a flash point no less than 38 degrees Celsius. Typical heating oil found in domestic steel tanks would meet or exceed these minimum limitations.

Description of the Prior Art

Prior art includes an Oil Alert system designed by Dorlen Products Inc. of Milwaukee, U.S.A., which features "Oil Alert Sensing Modules" which are absorbing cells which after insertion into the housing, are placed on the floor and will activate an audible alarm after the cells have detected oil. This prior art has limitations, which the invention will overcome. For example, this prior art requires cell replacement after triggering and cannot be easily self checked. The unit must be placed on a level surface, thus cannot act as an adjustable level alarm. There are other oil detection systems used in industrial

application such as detecting a liquid levels between double wall storage tanks. However, this prior art is intended to be used in this specific industrial applications. These known devices do not have an easy self-check mechanism, are not portable, and are typically not equipped with an audible alarm.

Other water detection alarm systems, utilize a conducting sensing method which cannot be used to detect the presence of oil due the fact oil acts as a poor electrical conductor.

The invention may be distinguished from the other prior water detection alarms in significant respect. Prior arts includes a variety of patents

pertaining to water leak detection devices which are designed to detect water and

automatically shut down an appliance or valve. Many prior arts utilize conductivity sensing probes, strips or cells to detect the presence of water from a leaking basement, appliance, or back-up pipe. An audible alarm will sound when moisture is detected . Representatives of this prior art are patents such as;

Cdn Patent No. 1261940, OTTERHOF, HENERY;
 Cdn Patent No. 2124907 JANESKY, LAWRENCE;
 Cdn.Patent No. 1244533 LEBLANC, JOSEPH;
 Cdn Patent No. 2023376 SHIH;
 Cdn Patent No. 2228517 ISAACSON;
 Cdn Patent No. 2175005 LEGER, LEBLANC;
 US Pat No. 5539383 CHIN, SUEY;
 US Pat No. 5058421 ALEXANDER, TOY, MARCH;
 US Pat No. 5091715 MURPHY;
 US Pat No. 4297686 TOM;
 US Pat No. 5898374 SCHEPKA;
 US Pat No. 5655561 WENDAL;
 US Pat No. 5557263 FISHER, JOHNSON;
 US Pat No. 5550532 MARSHALL;
 US Pat No. 4805662 MOODY;
 US Pat No. 4246575 PURTELL, PURTELL;
 US Pat No. 5517174 BARROWS;
 US Pat No. 4800372 POTEET;
 US Pat No. 4973947 TAX.

Other prior art utilizing conductive type detective systems can easily

false alarm when condensation forms on the probes. Absorption type units, which sit on the floor, will become submerged if the water level quickly rises, thus damaging the unit and causing it to malfunction.

The present invention shall be mounted directly above the monitoring

surface. The float can rest at any desired height above the monitoring surface, however the component housing must be mounted a minimum distance of 7 cm above the float and up to 807 cm directly above the liquid surface. The minimum distance can be lowered if required, although for most application this is not desired. Most prior art devices are fixed units, which are not adjustable once set in place. The length of the conductivity leads limits the range of these prior arts.

The invention is portable and can be moved from place to place, or it can be used to service different types of liquid applications. Today when areas become flooded, this alarm will enable a homeowner to set the positioning and height so that said house can be vacated when the alarm sounds. This would be a safety feature in areas under threat of potential flooding. Said alarm, offers portability, and flexibility, along with a reliable simple safety check for operability.

As stated, the present invention has a simple self check mechanism. A simple motion of raising the lever switch with a finger will allow the unit to be checked for all operational features. Other prior arts with self-check mechanisms require submersion in the water or liquid to be self-checked. This would, typically, be messy and difficult to perform.

Other prior arts devices generally may not incorporate a fail-safe mechanism, in the event the sensing device becomes disabled for any reason. If a dielectric capacitor, or absorbent cell becomes disabled for any reason, then the unit will not indicate a fault in the alarm unit. Some prior arts do include a battery low voltage-checking device.

Summary of the Invention

The invention provides a simple water or oil leak detection alarm system which is capable of producing an audible alarm when the liquid level increases above the point in which the unit is set to trigger. The invention would typically be used in a domestic home application for detecting water flooding, or a leaking oil tank installation. The invention can also be adapted for many industrial applications where the presence of a conductive or non conductive liquid requires alarming. In combination with its audible alarm, connections are provided for external monitoring, such as a home security system or relay controller. The invention utilizes a float, which can be adjusted to various heights above the area, which requires monitoring. The invention is portable and can be easily moved from one monitoring position to another, or from one liquid service to another. The invention requires a 9-volt battery, which is

checked continuously for sufficient voltage. The unit will sound the alarm when insufficient voltage is detected. A 120 volt ac/ 9-volt dc external supply can also be used to power this invention. The triggering mechanism of the invention requires a positive liquid level increase of approximately 5 mm after contact with the float to activate the alarm. This insures the unit does not false alarm with the presence of moisture, like many prior arts devices. The invention is ideally suited for monitoring oil leaks from domestic furnace tanks, which can leak at any time. By simply attaching the unit on the side of a pan (located under the tank), with hook and pile fastening material (e.g. Velcro (trademark)) or other commonly known fastening means, the unit will be fixed into position ready to detect a leak. The invention has a simple self-check feature. By the touch of a fingertip, the unit can be self checked to ensure all circuits are fully operational. A fail-safe design insures that in the event the float becomes disabled for any reason, the unit will sound the alarm.

The invention does not require conductive water detection systems for a triggering mechanism. It uses a float, attached to a lever switch, which upon coming in contact with a rising liquid, will cause the lever switch to rise, activating a spring-loaded switching mechanism.

The invention is portable and can be moved from place to place, or it can be used to service different types of liquid applications. Today when areas become flooded, this alarm will enable a homeowner to set the positioning and height so that the house can be vacated when the alarm sounds. This would be a safety feature in areas under treat of potential flooding. The alarm offers portability and flexibility, along with a reliable simple safety check for operability.

As stated, the invention has a simple self-check mechanism. A simple motion of raising the lever switch with a finger will allow the unit to be checked for all operational features. Other prior art devices with self-check mechanisms may require submersion in the water or liquid to be self-checked. This would, typically, be messy and difficult to perform.

The invention incorporates a fail-safe feature. Should the sensing device (float) become detached for any reason, the unit will automatically go into alarm mode.

The invention incorporates a low voltage battery monitoring system which will trigger the alarm circuitry should the battery fall below 7.4 volts. The unit will sound an audible alarm for a minimum of 24 hours in this condition, and will also trigger, if equipped, the external monitoring circuitry. The improvement of the 24 hour continuous alarm along with the triggering of the external circuit for low voltage conditions is an improvement over prior art devices. A new 9-volt alkaline battery will last a minimum of 1 year, in a non-

triggered operation mode. The unit may also operate continuously with an external 120 volt AC / 9 volt DC adapter.

The alarm system is capable of detecting both conductive and non-conductive liquid level increases, designed for indoor operation, and ideally suited for detecting basement flooding or leaky domestic steel oil tanks or other fluid containment devices. A float positioned above any surface such as a contained area (sump or drip pan), rises with the presence of a liquid allowing a spring-loaded switch to rise, triggering a 9-volt powered battery electric circuit. The electric circuit, enclosed in a plastic enclosure, activates an audible pulsating alarm when triggered. The alarm system is capable of generating a sound pulsating at the 85 dB level, preferably every 10 seconds. The alarm system is portable, and can be moved from one site to another, or from one service to another. The unit must sit directly above the site to be monitored, with a clear unencumbered path to the float mechanism. The height above the monitored surface where the alarm is placed can vary according to preference, from a minimum of 7cm to a maximum of 807 cm. The adjustment in height can be accomplished by utilizing 6.80 kg (breaking strength) braided nylon string which can be cut and tied to the desired length. A battery voltage monitor incorporated in the electric circuit, tests the battery voltage on a continuous bases, and will trigger the unit into alarm mode when the battery voltage is insufficient to sustain continuous operation. A simple convenient self-check feature allows the user to simply check the unit at any time. An external connection is provided to allow the unit to be connected to a home security system or other external device to allow extended protection or secondary operations.

DESCRIPTION OF THE DRAWINGS

The invention will now be described in greater detail with references to the accompanying drawings of the preferred embodiments, by way of example only, in which:

FIG.1 is a schematic illustration of the leak alarm system mounted off a concrete structure monitoring a concrete floor with the invention.

FIG.2 is a schematic illustration of the leak alarm system mounted on a containment pan monitoring a typical domestic oil tank with the invention.

FIG. 3 is perspective view showing the embodiment of the leak alarm system in accordance with the invention.

FIG.4 is a top, side and front view of the present invention.

FIG. 5 is a schematic diagram of an electrical circuit included in the leak alarm system of **FIG.1-4** in accordance with the present invention.

DETAILED DESCRIPTION OF THE INVENTION

Referring now to **FIG. 1** this is a schematic illustration of the leak alarm system mounted off a concrete wall monitoring a concrete floor. The housing **1** of the alarm system can be typically mounted using mating Velcro (trademark) surfaces **17** or other commonly known fastening means to insure the unit remains fixed in place during monitoring. The height above the surface to be monitored can be adjusted using a string **2** (common braided nylon fishing string) and can be adjusted from 7 cm to 807 cm provided the path of the string is not obstructed, and the float **3** is allowed to hang freely. The string must be measured cut and tied to the desired height. The float **3** constructed of cork or other floatable material, shall have a hole through the center to allow for the triangular metal wire float holder **8** to be inserted into each end. The triangular metal wire float holder **8** which is 7.6 cm in height can be tied with a string in order to locate the alarm unit at the desired height above the monitoring surface.

FIG.1 is a typical application where the unit is monitoring a basement floor or sump area **5**.

FIG. 2 is a schematic illustration of the leak alarm system **1** mounted on the side of a containment pan **6** monitoring a domestic oil tank **7** installation. The alarm is mounted on the side of the pan, using mating Velcro (trademark) surfaces **17** and utilizing an appropriately sized triangular metal wire **8**. The float **3** typically rests 3 mm off the bottom surface of the pan. Should the tank or any of the connections

leak allowing the float **3** to rise 4 mm in height, the alarm unit will sound. The alarm can be adapted for use with any size pan containing any liquid provided the specific gravity is above 775 Kg/m³. This allows the unit to be used in many domestic or industrial applications where leaks or floods are undesirable and need detecting. The specific gravity of the float mass must be capable of producing a buoyant force when submersed in a 775 kg/m³ liquid.

FIG. 3 is perspective view showing the preferred embodiment of the invention in greater detail. The housing **1** is constructed of plastic and contains the 9 volt battery compartment **11**, an electrical circuit board as shown schematically in **FIG. 5**, lever switch **18** for example Cherry Switch DA3C-H1AA (or equivalent), lever **9**, electrical Piezo **10**, external alarming connections **12**, and external power supply connection **13**. The housing **1** has openings cut or formed to allow the Piezo **10**, the lever **9**, and the external alarming connections **12** to protrude through housing. The lever **9** is allowed to travel freely in the slot provided on the front housing face **14** which accounts for the full lever operational travel. The rectangular housing has an opening to allow for an external power supply connection **13**. The lever **9** has a hole **15** located at the outer end to allow the triangular metal wire **8** to be passed through the hole prior to attachment to the float. The hole **15** also acts as the connection point for the braided nylon string should the monitoring height need adjustment. The housing can be separated into two pieces to allow for the insertion of the circuit board **FIG.5**. When in monitoring mode the float **3** hangs down compressing the lever switch **18** which puts the electrical circuit in battery checking mode. This allows for very little power to be used which accounts for the long operational life from a 9-volt battery. A 9-volt alkaline battery will last a minimum of 1 year. When the float **3** comes in contact with a liquid of sufficient height to raise the spring loaded lever switch **18**, the alarm circuit is activated, causing the external alarm connections **12** to either open or close (depending on external requirements) and the Piezo **10** to emit a sounding beep lasting approximately 1 second at 10 second intervals. The 10-second intervals allows the unit to be differentiated from other domestic type alarms and provide longer battery life. When the battery voltage is below 7.4 volts the alarm circuit also is activated causing the Piezo **10** to emit sounding beeps at 10 second intervals. At this voltage the alarm will sound for a minimum of 24 hours.

FIG.4 shows the top, front and side view of the present invention. The lever **9** is shown in the triggered position, i.e. unloaded (normally opened). In this position the spring and switch **19** integrated into the lever switch **18** is in its extended position. When loaded as depicted in **FIG.3** the lever **9** is compressing the spring and switch **19** (normally closed). The Velcro strips **17** located on the base

of the housing allow the unit to be firmly fixed in its monitoring position. The mating base surface shall also be affixed with Velcro or equivalent fastening mechanism. The alarm system will operate satisfactory without Velcro or other fastening devices, however it is recommended the unit be fastened to the mounting surface to avoid movement once set.

The present invention electrical control circuit is shown in **FIG.5**. This section describes the operation of this circuit. The electrical circuit uses comparators to evaluate the voltage of the battery. When the voltage of the battery drops below an adequate operating battery voltage or the float switch activation occurs; a signal is sent to the relay. This relay then sets the security system contacts to indicate an alarm and also starts the alarm sequence. The detailed operation of the comparator, relay and alarm sections are described below.

The comparator circuit consists of two Ultra Low-Power Comparators (U2 and U4) and supporting voltage divider components shown to the left of these comparators. Under normal non-alarm operation, this switch has the COM terminal connected to the N/O terminal. In this normal state the U4 output is high and the U2 output is low. If either the switch is activated by raising the float or the battery level drops to less than 7.4 volts the output of U2 will go high while the U4 output will go low. These two outputs are fed to the relay. Switch SW1 is shown in the “alarm” position.

The relay circuit has capacitors to limit the steady state power drawn by the DPDT relay (RX1). The relay is shown in the alarm state. A security system may be connected to the tabs which are directly connected to the relay. On the other side of the relay is the control of the internal alarm circuit. When in the “alarm” state the N/O terminal on pin 4 is grounded which enables the alarm sequence. If the battery fails at any time, the security contacts will indicate an alarm condition until power is resorted.

The alarm circuit consists mainly of the 555 timer (U3) and the Piezo (U1). When activated, the output of the timer goes low for approximately 1 second and high for approximately 9 seconds. The Piezo in turn generates an alarm for 1 second every 10 seconds.

The electrical circuit is powered by either a standard 9-volt battery or by a wall-mounted 9 volt AC/DC adapter. When the adapter is used, the battery is taken out of the circuit.

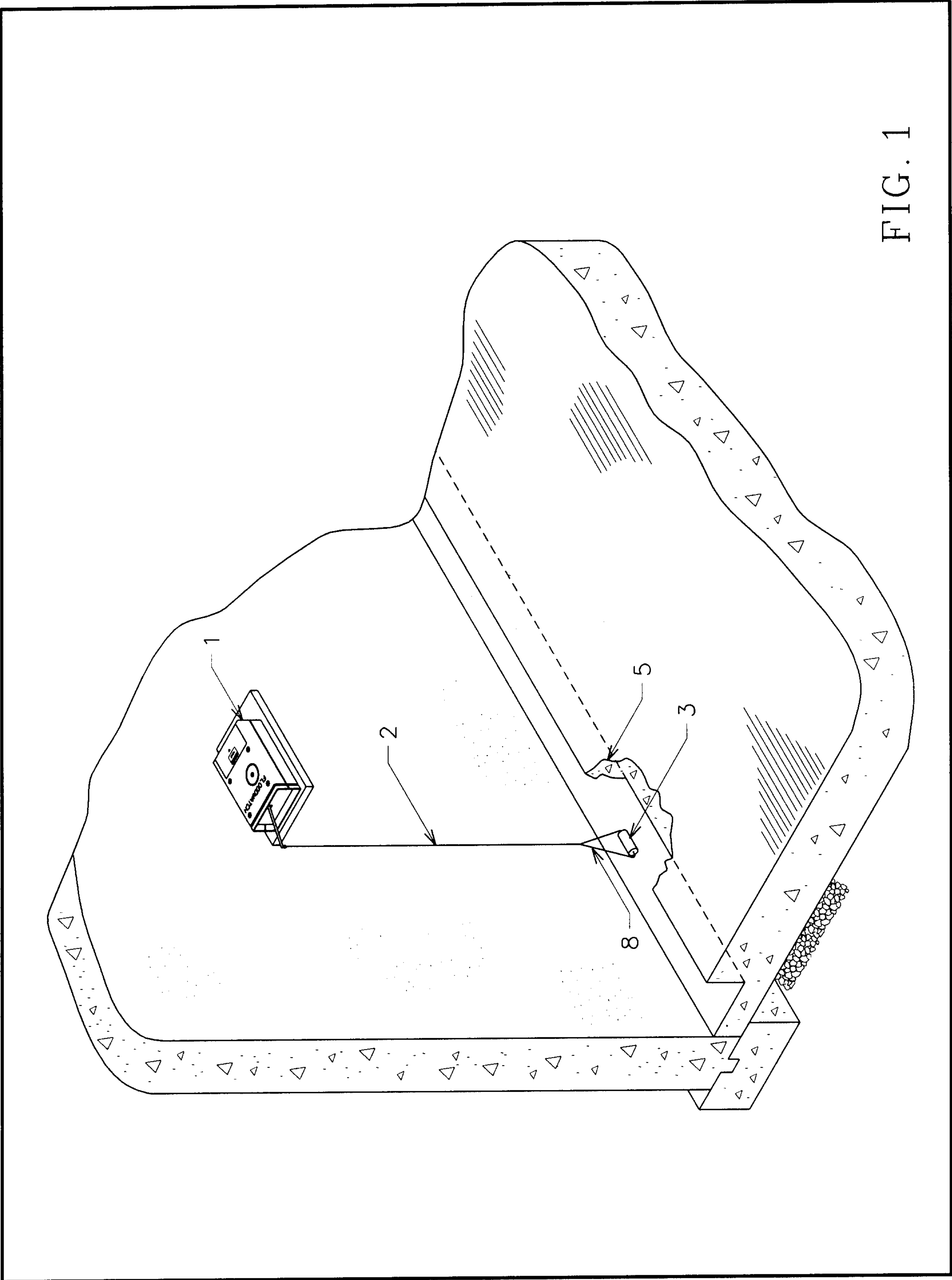
Claims

The embodiments of the invention in which an exclusive property or privilege is claimed are defined as follows:

What is claimed is:

1. A combustible liquid or water, level alarm device for indicating the leakage of a rising liquid, said device comprising:
 - a housing;
 - an electronic circuit within said housing, including an alarm means;
 - a trigger means for detecting a rising liquid;
 said trigger means comprising:
 - a lever switch within said housing;
 - a lever operatively attached to said lever switch, biased towards an alarm-triggering position by a biasing means;
 - a float assembly hanging from said lever, the weight of said float assembly being sufficient to downwardly overcome said upward biasing of said lever, such that said alarm means is not triggered until when and if said float assembly is elevated by said liquid rising to a height sufficient to float said float assembly; and a low voltage power source for said electronic circuit and alarm means to limit the heat generated by a current drawn from said power supply, thus allowing said alarm to be used for indicating the leakage of said rising liquid.
 said alarm means being arranged to emit a pulsed beeping sound allowing the alarm to be differentiated from other domestic type alarms and to provide longer battery life.
2. A liquid level alarm device according to claim 1, wherein said housing has an external connection for remote alarming and/or auxiliary control, operatively connected to said electronic circuit.
3. A liquid level alarm device according to claim 1, wherein said electronic circuit includes a power supply monitoring circuit operatively connected to said power supply for monitoring the strength of said power supply and for triggering a low power supply alarm should the power supply strength drop below a predetermined level.
4. A liquid level alarm device according to claim 1, wherein said pulsed beeping sounds last approximately 1 second at 10 second intervals.

5. A liquid level alarm device according to claim 1, wherein the height of said float is adjustable.
6. A liquid level alarm device according to claim 1, wherein a string of adjustable length, is attached between said level and said float assembly, to position said float assembly at a height at which said alarm is desired to be triggered.



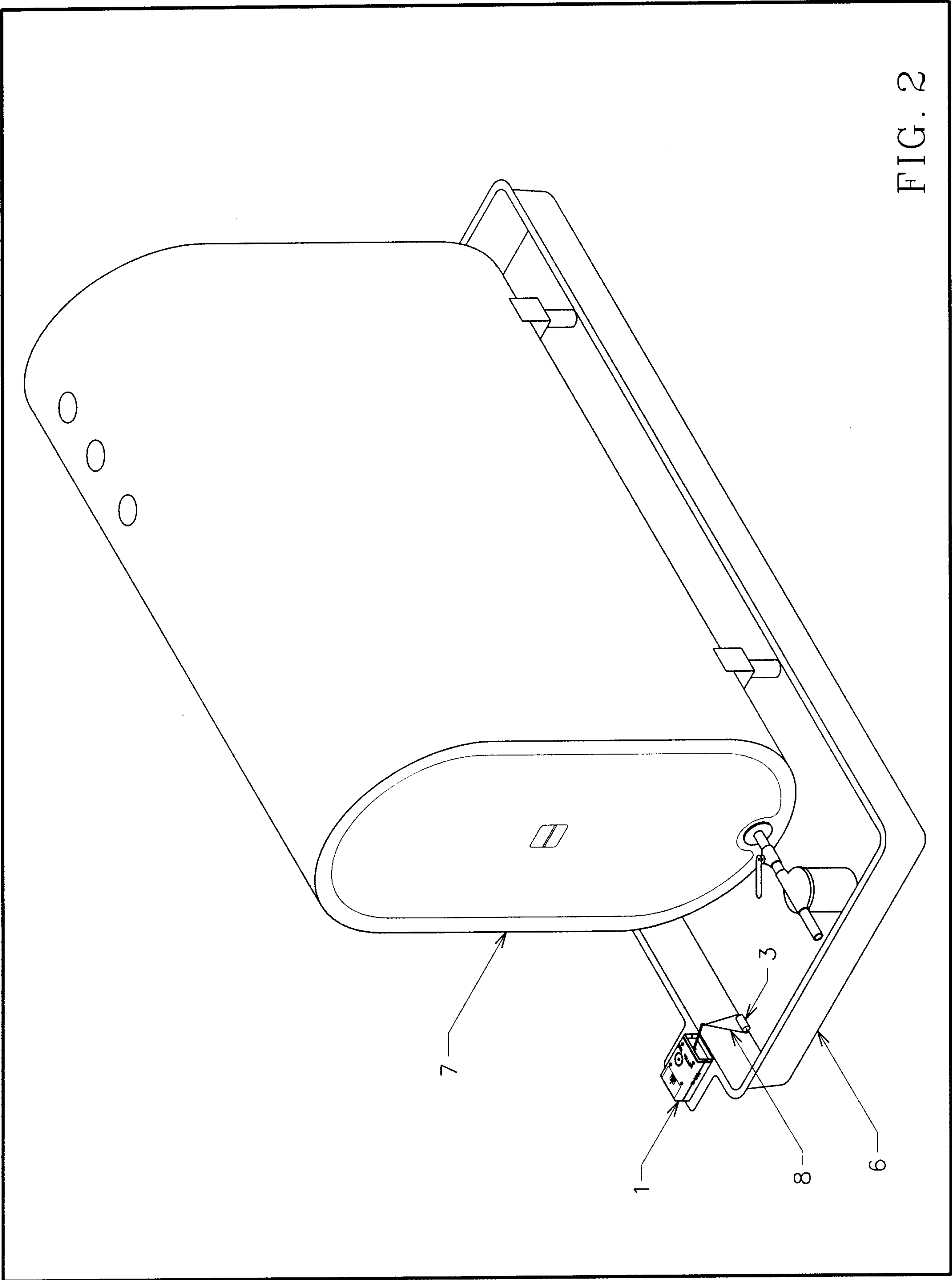


FIG. 2

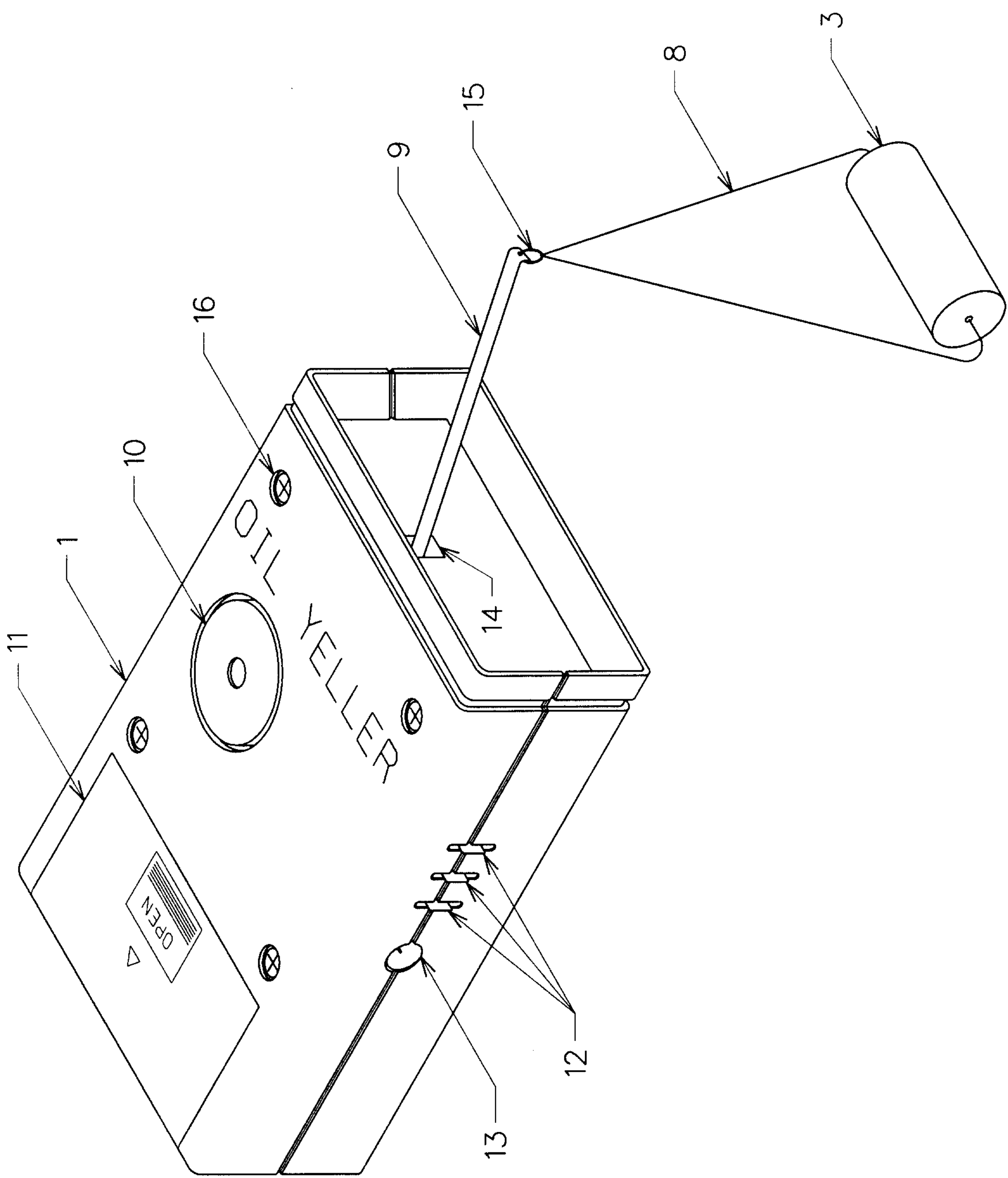


FIG. 3

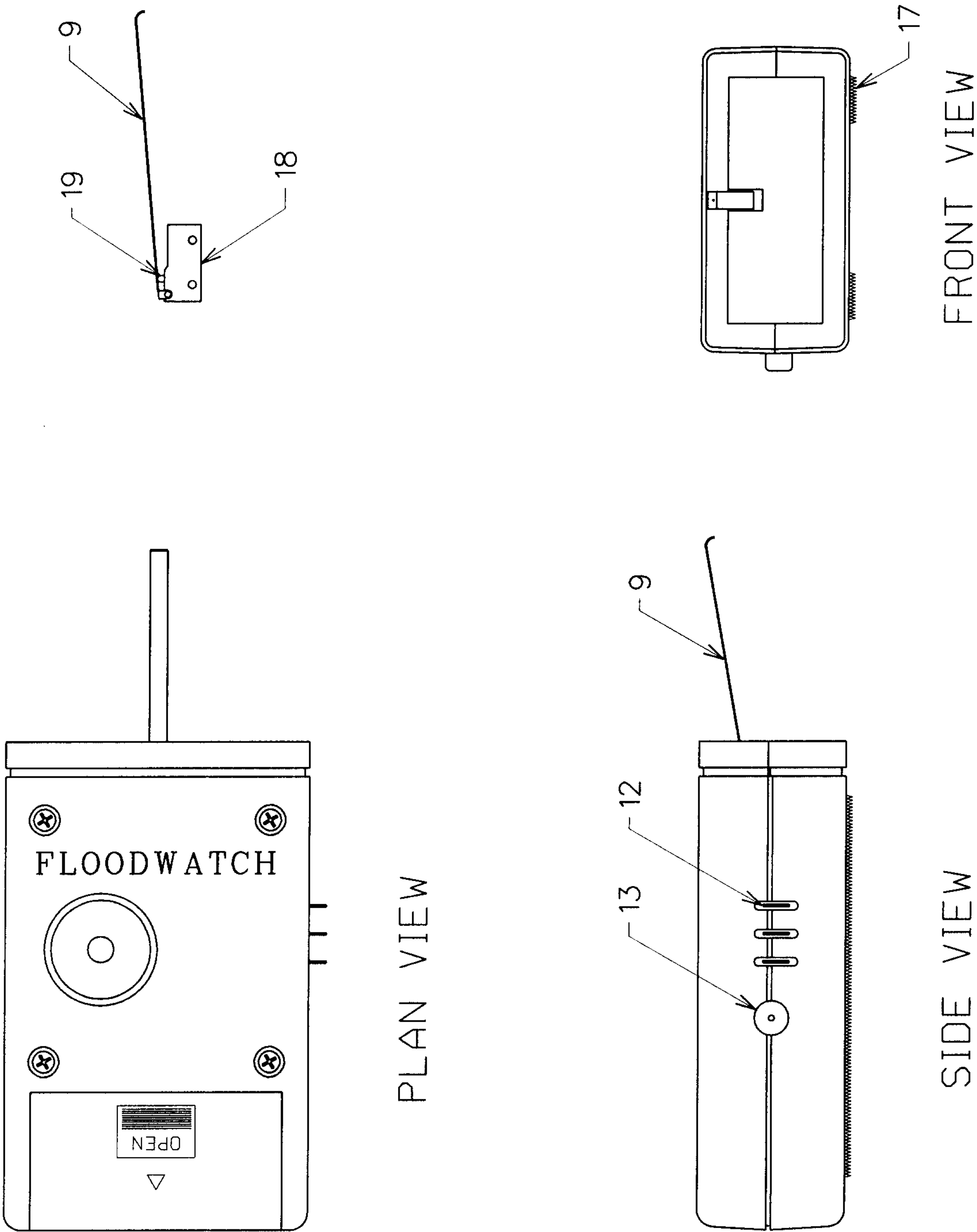
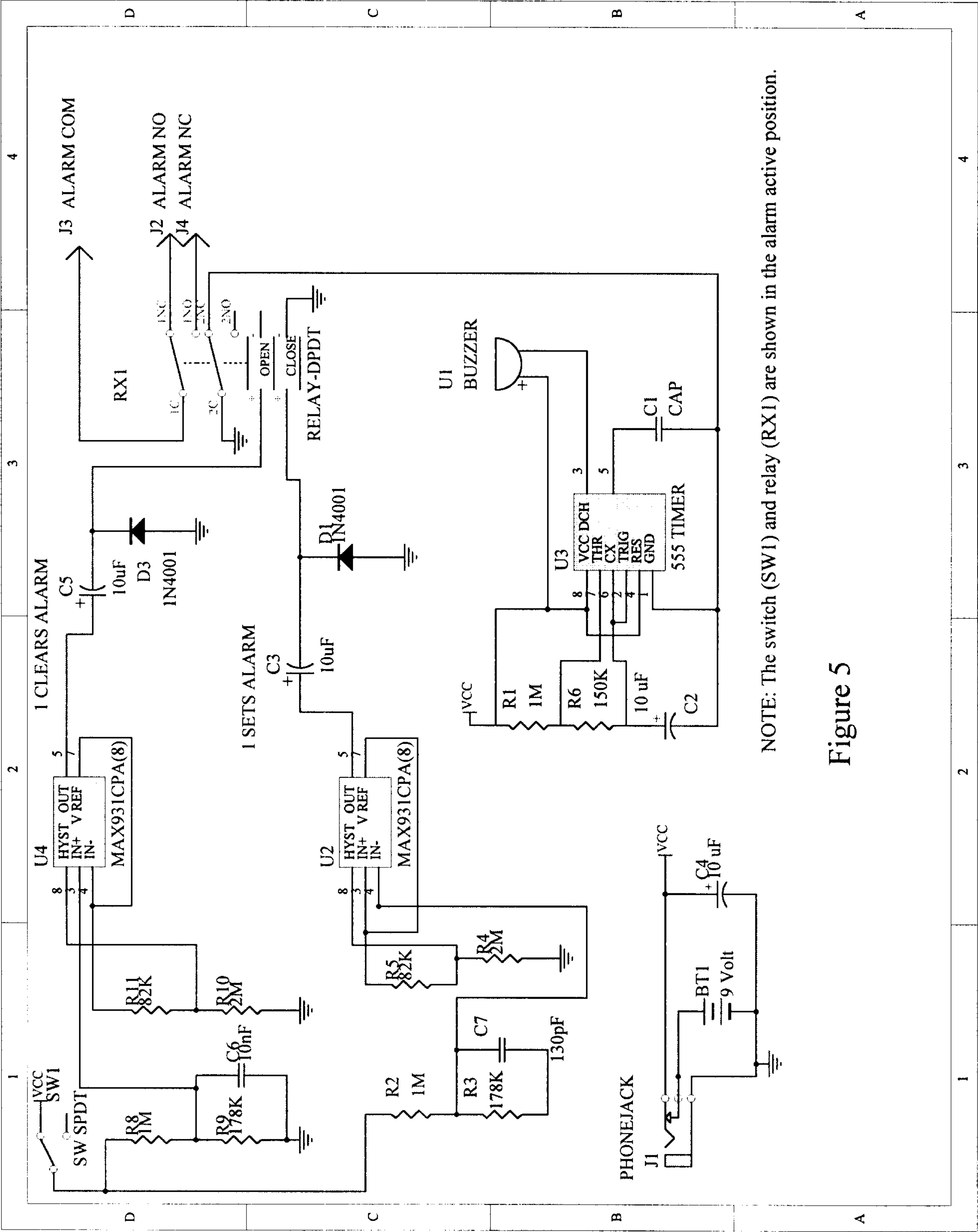


FIG. 4



NOTE: The switch (SW1) and relay (RX1) are shown in the alarm active position.

Figure 5

