

Programmable Pressure Activated Floatation Trigger Device

Field of Invention

[0001] The present invention relates to a programmable pressure activated floatation trigger device for use on a life vest. In particular, the invention relates to an inflation trigger device that has adjustable water pressure trigger levels.

Background

[0002] Water sports held in indoor environment are generally safe and risks of drowning is low. However, water sports held in outdoor environments, like lakes, rivers and seas, are potentially un-safe; for example, strong under-currents in the outdoor environments may not be predictable and water enthusiasts are often unaware of their physical limits. When caught in a panic situation, they could be quickly exhausted. To reduce the risks of drowning, a sportsman usually wears a life vest.

[0003] There are various forms of life vests. In general, there are two types of life vests; the first type is non-inflatable whilst the second type is inflatable. The non-inflatable life vest contains floating inserts and are thus generally bulky; very often, they inhibit movements of a swimmer. The inflatable type is less bulky and therefore is more suitable for sportspersons; inflation via a compressed air canister may be activated by contact with water, pulling a rip cord or by a pressure sensor.

[0004] FIG. 1 illustrates a conventional inflation device 10 for use with a life vest 12. The inflation device 10 has a generally flat inflation body 20 and a gas/CO² canister C and water sensing cartridge 30 attached separately to the inflation body 20. The inflation body 20, similar to an MK5 inflator manufactured by United Molders Ltd, offers both manual and automatic inflation. To manually activate the inflation device 10, a rip cord 21 is tugged, thereby causing a plunger 22 (not shown in figure) to move and to pierce a seal on an end of the gas/CO² canister C that is screwed into the inflation body 20. On the other hand, when the inflation device 10 touches water, a paper element 32 (not shown in figure) in the water sensing cartridge 30 becomes wet

and disintegrated and this triggers a compression spring 34 (not shown in figure) in the water sensing cartridge 30 to push the plunger 22 in the inflation body 20 to pierce the seal on the screw end of the gas/ CO^2 canister C. Through a thickness of the inflation body 20 is a D-shaped hole 24. In communication with a chamber enclosing the plunger 22 is a gas discharge hole 26, which opens into the D-shaped hole 24. On an exterior of a life vest is an inflation stem 40, which is attached sealingly through a thickness of the life vest fabric. The inflation device 10 is attached to the life vest by a nut on the inflation stem 40. The inflation stem 40 has a manifold 42, which communicates with the gas discharge hole 26. The manifold 42 is joined by an internal bore 44 in the inflation stem 40 and leads to an interior of the life vest. When the seal on the screw end of the gas/ CO^2 canister C is broken, compressed gas/ CO^2 is released into the interior of the life vest through the internal bore 44, manifold 42 and gas discharge hole 26 for inflation of the life vest 12.

[0005] Automatic inflatable life vest may not be suitable for some sportspersons, for example, in snorkeling, where some depth of submersion in water is desirable. On the other hand, manual trigger of inflatable life vest may not provide sufficient safety in that a person who is drowning may not be able to exercise judgment in triggering inflation of one's life vest. US Patent No. 5,271,525 by Petrie describes such a manually activated trigger device.

[0006] US Patent No. 4,968,277, assigned to Eagle Electronics, Inc., describes an automatic floatation device that is controlled by a pressure sensor and an electric circuit. When a swimmer wearing the floatation device is below a first depth of water for a given period of time or below a second, greater depth for any period of time, a gas canister is fired to inflate a bladder to bring the swimmer to the water surface.

[0007] Despite development of trigger devices for life vests, there exists a need for a simple yet effective floatation trigger device that can overcome the shortcomings of the existing prior art.

Summary

[0008] The following presents a simplified summary to provide a basic understanding of the present invention. This summary is not an extensive overview of the invention, and is not intended to identify key features of the invention. Rather, it is to present some of the inventive concepts of this invention in a generalised form as a prelude to the detailed description that is to follow.

[0009] The present invention seeks to provide an inflatable life vest for a swimmer. The life vest when not inflated is fitting on a swimmer and does not substantially restrict movements of the person.

[0010] In one embodiment, the present invention provides a programmable pressure activated floatation trigger device. The floatation trigger device comprises: a hollow box housing defining an internal cavity; and an inflation assembly for connection to the box housing, said inflation assembly comprises a gas canister being connectable to an inflation body and a water sensing cartridge being connectable separately to the inflation body; wherein the internal cavity is operable to house a pump; a water sensor; a pressure sensor; and a controller, such that an outlet port of the pump is connectable to the water sensing cartridge so that when the trigger device is submerged under water and the pressure sensor detects a predetermined pressure is breached, the controller activates the pump to deliver a liquid to the water sensing cartridge for it to trigger releasing gas from the gas canister to inflate a life vest associated with the trigger device.

[0011] In another embodiment, the present invention provides a trigger method for a life vest. The trigger method comprises: detecting presence of water by a sensor; switching a controller disposed inside a housing to a sleep mode when the life vest is not in contact with water and the water sensor is not activated, or switching to an operation mode when the life vest is in submerged with water and the water sensor is activated; and pumping a liquid via a pump into a water sensing cartridge for triggering a gas canister to inflate the life vest when the controller is in the operation mode and a pressure sensor detects that a predetermined pressure is breached.

[0012] In one embodiment, the trigger device comprises a cavity to sealingly house the water sensing cartridge. In another embodiment, the housing comprises an L-shaped body and an arm, wherein the arm has an internal fluid channel for liquid flow from the pump to the water sensing cartridge. In yet another embodiment, the trigger device comprises a liquid cartridge for supplying liquid to the pump.

[0013] In one embodiment of the trigger device, the controller comprises a microprocessor mountable on a printed circuit board (PCB). The microprocessor and/or PCB has a memory unit.

[0014] In one embodiment of the trigger device, the water sensor, pressure sensor, buzzer and/or visual indicator(s) are mounted on the device housing. In another embodiment, these devices are mounted remotely on a pendant unit connected to the housing. In one embodiment, the water sensor comprises probes, which are used for both setting the predetermined water pressure and predetermined time of activation of the pressure sensor and retrieval of data/event logging at a docking station.

Brief Description of the Drawings

[0015] This invention will be described by way of non-limiting embodiments of the present invention, with reference to the accompanying drawings, in which:

[0016] FIG. 1 illustrates a conventional floatation trigger device for use with a life vest;

[0017] FIG. 2A illustrates a pressure activated trigger device for a life vest according to an embodiment of the present invention;

FIG. 2B illustrates a known inflation device being modified with an adaptor between a water sensing cartridge and an inflation body according to another embodiment of the present invention; and

FIG. 2C illustrates schematic functions of a controller for use with the trigger device shown in FIG. 2A;

[0018] FIG. 3 illustrates a process or operation of the trigger device shown in FIG. 2A; and

[0019] FIG. 4A shows a side view of a pressure activated trigger device according to another embodiment of the present invention; and FIG. 4B shows a perspective view of the trigger device shown in FIG. 4A.

Detailed Description

[0020] One or more specific and alternative embodiments of the present invention will now be described with reference to the attached drawings. It shall be apparent to one skilled in the art, however, that this invention may be practised without such specific details. Some of the details may not be described at length so as not to obscure the invention. For ease of reference, common reference numerals or series of numerals will be used throughout the figures when referring to the same or similar features common to the figures.

[0021] FIG. 2A shows an exploded view of a pressure activated floatation trigger device 100 according to an embodiment of the present invention. As shown in FIG. 2A, the pressure activated floatation trigger device 100 is installed in a housing 110. The housing 110 is substantially a hollow box 112 having an internal cavity 113 and a lid 114 over the box 112. A gasket 116 is disposed between the box 112 and the lid 114 to ensure that the internal cavity 113 is water tight. On a right hand side of a lateral face of the hollow box 112, as seen in FIG. 2A, is a liquid reservoir port 120. The liquid reservoir port 120 is in communication with the internal cavity 113 of the box 112 and is sized and dimensioned to receive a liquid cartridge 122. The liquid reservoir port 120 is closeable by a cap 124. Adjacent to the liquid reservoir port 120 is a threaded adaptor port 130. The adaptor port 130 leads to a cartridge cavity 132 that is sized and dimensioned to receive the water sensing cartridge 30 shown in FIG. 1. Near the end of the cartridge cavity 132 is a passageway 134 for providing fluid communication between the cartridge cavity 132 and the internal cavity 113.

[0022] In one embodiment, the cap 124 ensures that the internal cavity 113 of the box 112 remains water tight. In another embodiment, an “O” ring is provided between the liquid cartridge 122 and the liquid reservoir port 120 to ensure water tightness.

[0023] FIG. 2B shows a known inflation trigger device shown in FIG. 1 after being modified with a hollow adaptor 131 for mounting the water sensing cartridge 30 onto the adaptor port 130 on the housing 110. The adaptor 131, as seen in FIG. 2B, has a female thread 131a on the right hand side for engaging with mating part on the inflation body 20. Coaxial with female thread 131a but on the left hand side of the adaptor 131 is a male thread 131b. The male thread 131b matches the female thread on a connection end of the water sensing cartridge 30. Coaxial with the female thread 131a and male thread 131b but on a cylindrical surface is another male thread 131c. This another male thread 131c matches that on the adaptor port 130 on the housing 110. Coaxial with the male thread 131c is a hexagonal surface 131d. Between the hexagonal surface 131d and the male thread 131c is a surface to receive an “O” ring 131e for sealing the connecting surfaces between the adaptor 131 and the adaptor port 130 on the housing 130. Due to the length of the adaptor 131, an actuator extender 131f corresponding to the added length of the adaptor 131 is disposed inside the hollow adaptor 131 so that the mechanism in the water sensing cartridge 30 and plunger 22 are physically connected.

[0024] Referring back to FIG. 2A, it shows a supply conduit S connecting the liquid cartridge 122 to an inlet port 141 of a pump 140. An outlet port of the pump 140 is connected by another conduit to the passageway 134. The pump 140 is connected electrically to a printed circuit board (PCB) 150, on which is a pump driver 142. The pump driver 142 is then controlled by a controller 160, which uses an Intel 8051 microprocessor. The PCB 150 is shown to be mounted on the inside face of the lid 114. Also mounted on the inside face but sealingly exposed to the outside face of the lid 114, are two water sensing probes 171, 172, a pressure sensor 180 and a buzzer B. In an implementation, the pressure sensor 180 is obtained from Intersema, vide part no. MS5535B.

[0025] The functions of the electronic components on the PCB 150 are shown schematically in FIG. 2C. As shown in FIG. 2C, there is additionally a clock signal, a

battery 190 and a battery monitor 192 connected to the PCB 150. The battery life monitor 192 monitors the remaining power of the battery 190. If the battery power is low, the battery life monitor 192 alerts the user by activating the buzzer B. When the life vest 12 is not in contact with water and no water sensing signal is received by the controller 160, the controller 160 switches the floatation trigger device 100 to a sleep mode and supplies power to only the water sensor and battery monitor 192. When the life vest 12 is in contact with water and a positive water sensing signal is received by the controller 160, the controller 160 switches the floatation device 100 to an operation mode and monitors the water pressure signal; once the water pressure signal exceeds a set or predetermined pressure, the controller 160 activates the pump driver 142 for the pump 140 to operate. Operation of the pump 140 supplies liquid from the liquid cartridge 122 into the cartridge cavity 132. Upon contact with the liquid, the paper element in the water sensing cartridge 30 becomes wet and thereby causes the plunger to extend and to pierce the seal of the gas canister C so as to inflate the life vest 12 and bring the user back to a water surface.

[0026] FIG. 3 shows the operation 300 of the pressure activated floatation trigger device 100 according to another embodiment of the present invention. As shown in FIG. 3, the operation 300 of the trigger device 100 starts at step 305, for example, by powering up the device. From step 305, the operation proceeds to step 310 for device initializations, for example, setting the immersion threshold and warning period(s) for the trigger device 100 to activate and/or in preparation for data logging. From step 310, it proceeds to step 315, in which power level of the battery 190 is checked by the battery monitor circuit 192.

[0027] Proceeding, a decision is made, in step 320, whether the power level of the battery 190 is low. If the decision is positive, operation proceeds to step 325 and the buzzer B is activated, and operation ends at step 390, for example, by powering down the device 100. If the decision is negative, meaning that the battery 190 has sufficient power, for example, for the next two hours or more, operation proceeds to step 330.

[0028] In step 330, the water probes 171,172 are activated and a decision is made, in step 335, whether water is present between the probes 171,172. If the decision in step

335 is positive, the controller 160 would power up the pressure sensor 180 and obtain data from the pressure sensor 180, in step 340. Following this, the controller calculates the depth of immersion of the device 100, in step 345, and a decision is made, in step 350, whether the depth of immersion is equal or greater than the threshold depth. If the decision in step 350 is positive, the pump 140 is activated. At the same time, the buzzer B is also activated, for example, to warn the user that one's life vest would be inflated within a predetermined time. If the life vest is inflated, the operation of the trigger device 100 stops, in step 390, and the user has to return the life vest 12 for the water sensing cartridge 30 to be replaced so that the life vest can be re-used. If the decision in step 350 is negative, operation of the trigger device 100 reverts back to step 315 for polling of the battery power.

[0029] Referring back to FIG. 3, if the decision in step 335 is negative, the controller 160 switches the trigger device 100 from an operation mode to a sleep mode, in step 370. When the trigger device is in the sleep mode, the water probes 171,172 are active and continue to detect presence of water between the water probes by using, for example, a low power passive circuit, in step 375. If no water is detected, in decision step 380, the controller 160 continues to poll the water probes and executes step 375. If water is detected, in decision step 380, an interrupt is generated to switch the controller 160 from the sleep mode back to the operation mode and operation of the trigger device 100 reverts back to step 310 or 315.

[0030] Alternatively, but not shown in FIG. 3, if the depth of immersion is breached, after decision step 350, the buzzer B is activated by a first tone or pitch to warn the user that one's life vest 12 would be inflated if immersion is maintained longer than a first predetermined period of time. If the user moves towards the surface and the pressure sensor 180 is de-activated within the first predetermined period of time, the controller 160 would not activate the pump 140. If the depth of immersion is breached and maintained longer than the first predetermined period, the controller 160 would activate the buzzer B to give a second tone or pitch for a second predetermined period. If the pressure sensor 180 is deactivated, the buzzer B may revert to the first tone/pitch and the first predetermined period is reset or the buzzer B may be reset altogether depending on the immersion of the user.

[0031] In the above embodiment of the trigger device 100, the water probes 171,172 are additionally used to extract data that are logged into the controller 160 when the trigger device 100 is attached to a docking station (not shown) in the figures. Data logging in the trigger device 100 may be stored in a memory in the controller or associated microprocessor or in a removeable data media. In another embodiment of the trigger device 100, the water probes comprises four sensors 171,172,171a,172a. When the probe sensors 171,172 are activated, for example, by a wet finger, activation of either additional probe 171a,172a increases or decreases the immersion/depth threshold setting of the pressure sensor 180. In yet another embodiment of the trigger device, the water probes 171,172 has two membrane switches 171b, 172b. The membrane switches are used increase/decrease the immersion/depth setting of the pressure sensor 180.

[0032] In another embodiment of the trigger device 100, different voltage levels may be applied across the probe sensors 171,172 to switch the modes of initialization of parameters in step 310 and the other probes 171a,172a may be used to increase or decrease the parameter settings; in an implementation, the inside face of the lid 114 has two or more indicators 195, one indicator for indicating the water threshold level, another for indicating the buzzer warning period. An additional indicator may be used to show a second buzzer warning period. In one embodiment, the indicator is coded according to the depth of immersion or time period; in another, the depth indication is calibrated according to the depth of immersion, for example, in metres of water and the time in minutes. In one embodiment of the indicator, the indicator 195 is a 7-segment display; in another embodiment, the indicator 195 is a bar-type display. In yet another embodiment of the trigger device, the trigger device 100 comprises a pendant box 200 for housing the water probe sensors 171,172,171a,172a, pressure sensor 180, buzzer B and indicators 195. The buzzer B may provide audio warning in addition or alternative to visual warning from the indicators 195.

[0033] FIGs. 4A and 4B show another trigger device 400 according to another embodiment of the present invention. As shown in FIGs. 4A and 4B, the trigger device 400 comprises a known inflation device 10 and a substantially L-shaped housing 410.

The L-shaped housing 410 comprises a main body and an arm 411. The arm 411 is connected to an end of the water sensing cartridge 30 of the inflation device 10. In addition, the main body of the L-shaped housing has a clip 415. The clip 415 is arranged such that it holds the main body of the L-shaped housing 410 to the inflation body 20 of the inflation device 10. Inside the main body of the L-shaped housing 410 (but not shown in FIGs. 4A or 4B) is a liquid cartridge 422 connected a pump 440, with an outlet of the pump 440 being connected to a passageway in the arm 411 to the water sensing cartridge 30. The liquid cartridge 422 is similar to the above liquid cartridge 122 and no further description is provided; similarly, pump 440 is similar to the earlier pump 140. Also inside the L-shaped body of the L-shaped housing 410 is a PCB 450, a pump driver 442, a controller 460, battery 490, battery monitor 492, water probe sensors 471,472, pressure sensor 480 and buzzer B. In one embodiment, the water probe sensors 471,472, pressure sensor 480 and buzzer B are arranged on a panel on the main body of the L-shaped housing. In another embodiment, the panel is remotely mounted on a separate pendant box.

[0034] In another embodiment of the trigger device 400, the clip 415 is arranged to engage with an external surface of an adaptor 431 between the water sensing cartridge 30 and inflation body 20; the adaptor 431 is similar to that of adaptor 131 shown in FIG. 2B. In yet another embodiment of the trigger device 400, the clip 415 is a stand-alone unit separate from the main body of the L-shaped housing 410 or inflator 10.

[0035] While specific embodiments have been described and illustrated, it is understood that many changes, modifications, variations and combinations thereof could be made to the present invention without departing from the scope of the invention. For example, an advantage of providing a separate liquid cartridge 122,422 is that the life vest 12 may be put to use in murky water; the liquid cartridge 122,422 minimizes the risks of the life vests 121 from failing to save lives in such environments. When the life vests are put to use in normal water environments, a filter an/or strainer unit may be provided instead of the liquid cartridge 122,422.

CLAIMS:

1. A programmable pressure activated floatation trigger device comprising:
a hollow box housing defining an internal cavity; and
an inflation assembly for connection to the box housing, said inflation assembly comprises a gas canister being connectable to an inflation body and a water sensing cartridge being connectable separately to the inflation body;
wherein the internal cavity is operable to house a pump; a water sensor; a pressure sensor; and a controller, such that an outlet port of the pump is connectable to the water sensing cartridge so that when the trigger device is submerged under water and the pressure sensor detects a predetermined pressure is breached, the controller activates the pump to deliver a liquid to the water sensing cartridge for it to trigger releasing gas from the gas canister to inflate a life vest associated with the trigger device.
2. A floatation trigger device according to claim 1, wherein the housing defines another cavity to sealingly house the water sensing cartridge.
3. A floatation trigger device according to claim 1, wherein the housing defines an L-shaped body and an arm, said arm having an internal fluid channel for liquid flow from the pump to the water sensing cartridge.
4. A floatation trigger device according to claim 2 or 3, further comprising an adaptor and actuator extender for connecting the water sensing cartridge to the inflation body.
5. A floatation trigger device according to any one of claims 1-4, further comprising a liquid cartridge for supplying liquid to the pump.
6. A floatation trigger device according to any one of claims 1-5, wherein the controller comprises a microprocessor, which is mounted on a printed circuit board.

7. A floatation trigger device according to any one of claims 1-6, wherein the water sensor comprises two probes.
8. A floatation trigger device according to claim 7, wherein the water sensor further comprises two probes.
9. A floatation trigger device according to any one of claims 1-8, further comprising a buzzer and/or visual indicator(s).
10. A floatation trigger device according to claim 9, wherein the water sensor, pressure sensor, buzzer and visual indicator(s) are disposed on a pendant unit attached to the housing.
11. A floatation trigger device according to any one of claims 6-10, wherein the controller comprises a memory unit and/or the printed circuit board comprises a connector for a removeable memory unit.
12. A floatation trigger device according to any one of claims 1-11, wherein the controller further comprises a battery monitor to give a warning when the battery level is at or below a predetermined power level.
13. A trigger process of a life vest, the process comprising:
 - detecting presence of water by a sensor;
 - switching a controller disposed inside a housing to a sleep mode when the life vest is not in contact with water and the water sensor is not activated, or switching to an operation mode when the life vest is submerged with water and the water sensor is activated; and
 - pumping a liquid via a pump into a water sensing cartridge for triggering a gas canister to inflate the life vest when the controller is in the operation mode and a pressure sensor detects that a predetermined pressure is breached.

14. A trigger process according to claim 13, further comprising setting off an indicator when the predetermined pressure is breached but before pumping the liquid into the water sensing cartridge.

15. A trigger process according to claim 14, further comprising setting off the indicator when a second predetermined pressure is breached but before pumping the liquid into the water sensing cartridge.

16. A trigger process according to claim 14 or 15, further comprising a predetermined time period of activation of the pressure sensor before pumping the liquid into the water sensing cartridge.

17. A trigger process according to claim 16, wherein the indicator is canceled when the pressure sensor is deactivated by a user reducing one's depth of immersion within the predetermined time period.

18. A trigger process according to any one of claims 14-17, wherein the indicator is a buzzer and/or visual indicator(s).

19. A trigger process according to any one of claims 16-18, wherein the water sensor comprises two or more probes, said probes are operable for setting the predetermined pressure of the pressure sensor and/or predetermined time of activation of the pressure sensor.

20. A trigger process according to any one of claims 13-19, wherein the controller comprises a memory unit and/or a connector for a removeable memory unit, said memory unit allowing time and events during the operation mode to be logged and the resultant data to be retrieved.

21. A trigger process according to any one of claims 13-20, further comprising supplying a liquid to the pump from a liquid cartridge.

22. A trigger process according to any one of claims 14-21, further comprising monitoring the power level of a battery of the device and giving a warning via the indicator if the power level is at or below a predetermined level.