



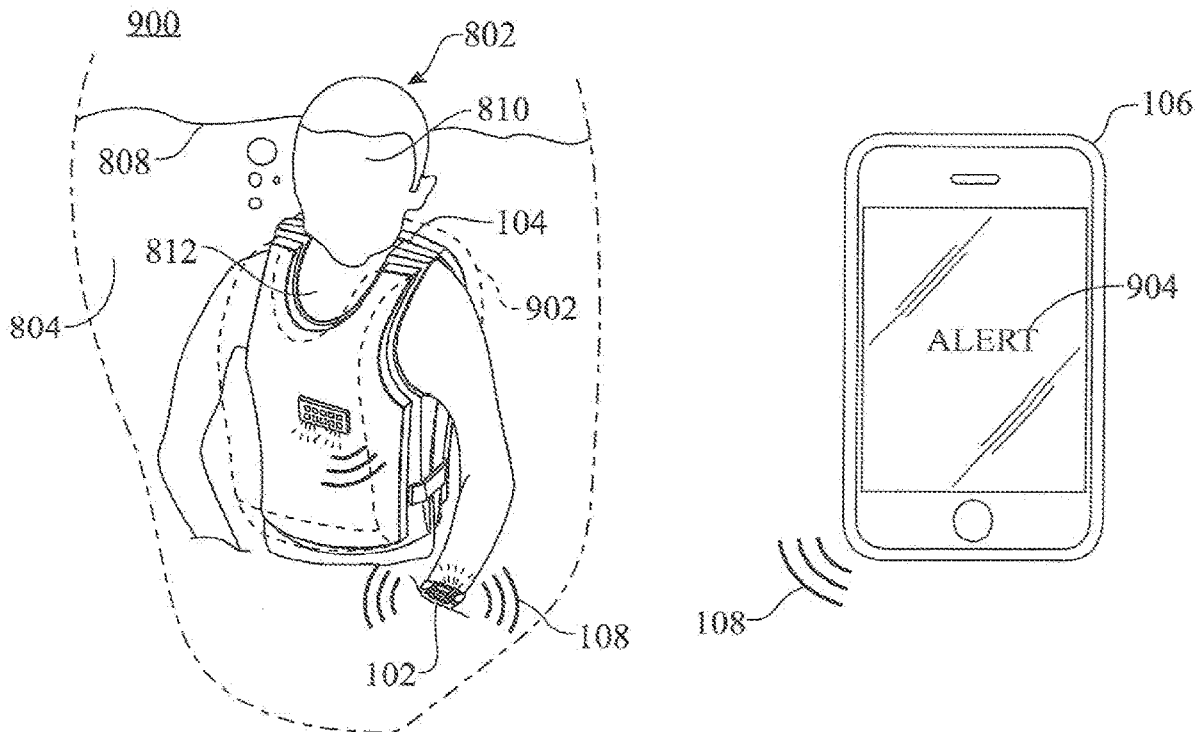
US 20210403132A1

(19) **United States**(12) **Patent Application Publication**
Pourmasiha(10) **Pub. No.: US 2021/0403132 A1**(43) **Pub. Date: Dec. 30, 2021**(54) **PERSONAL AQUATIC SAFETY DEVICE**(71) Applicant: **Niloufar Pourmasiha**, Parkland, FL
(US)(72) Inventor: **Niloufar Pourmasiha**, Parkland, FL
(US)(21) Appl. No.: **17/358,874**(22) Filed: **Jun. 25, 2021****Related U.S. Application Data**(60) Provisional application No. 63/043,925, filed on Jun.
25, 2020.**Publication Classification**(51) **Int. Cl.**
B63C 9/00 (2006.01)(52) **U.S. Cl.**CPC **B63C 9/0005** (2013.01); **B63C 2009/0017**
(2013.01); **B63B 2201/00** (2013.01); **B63C**
2009/007 (2013.01); **B63C 2009/0047**
(2013.01)

(57)

ABSTRACT

A personal aquatic safety system includes a device that monitors vital signs of the wearer. If one or more of the monitored vital signs falls outside predetermined acceptable parameters, the safety device will emit an alarm and send a wireless distress signal. The safety device may be integrated into a garment such as an inflatable vest and maybe programs to automatically inflate pockets in the vest when the safety device detects that the wearer is experiencing physical distress based on the readings of the vital sign monitor. The monitoring device may also include a deployable tracker that can be released from the safety device and sent to the surface of a body of water so that it may emit a visual and audio alarms, and sends a wireless distress signal.



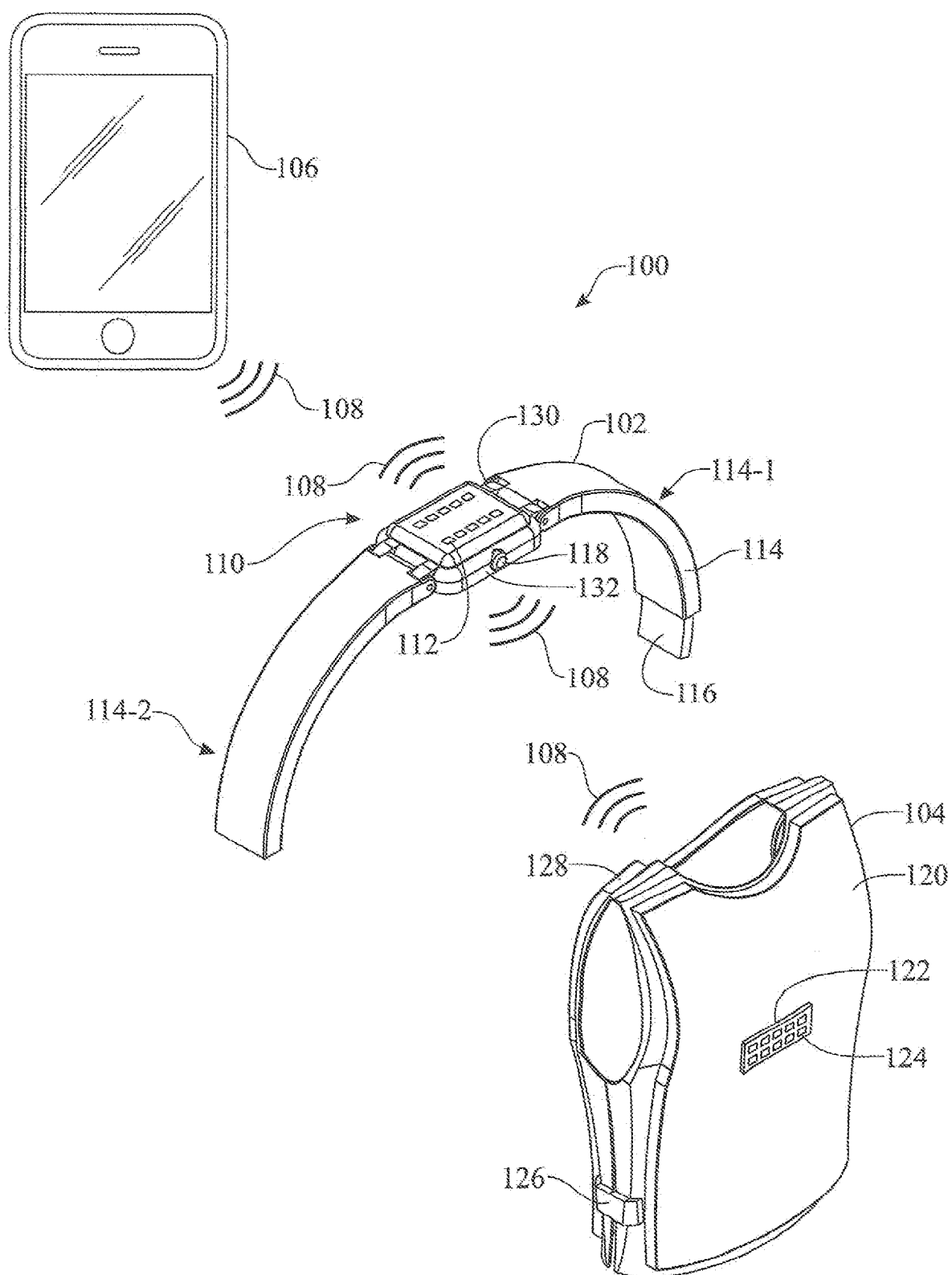


FIG. 1

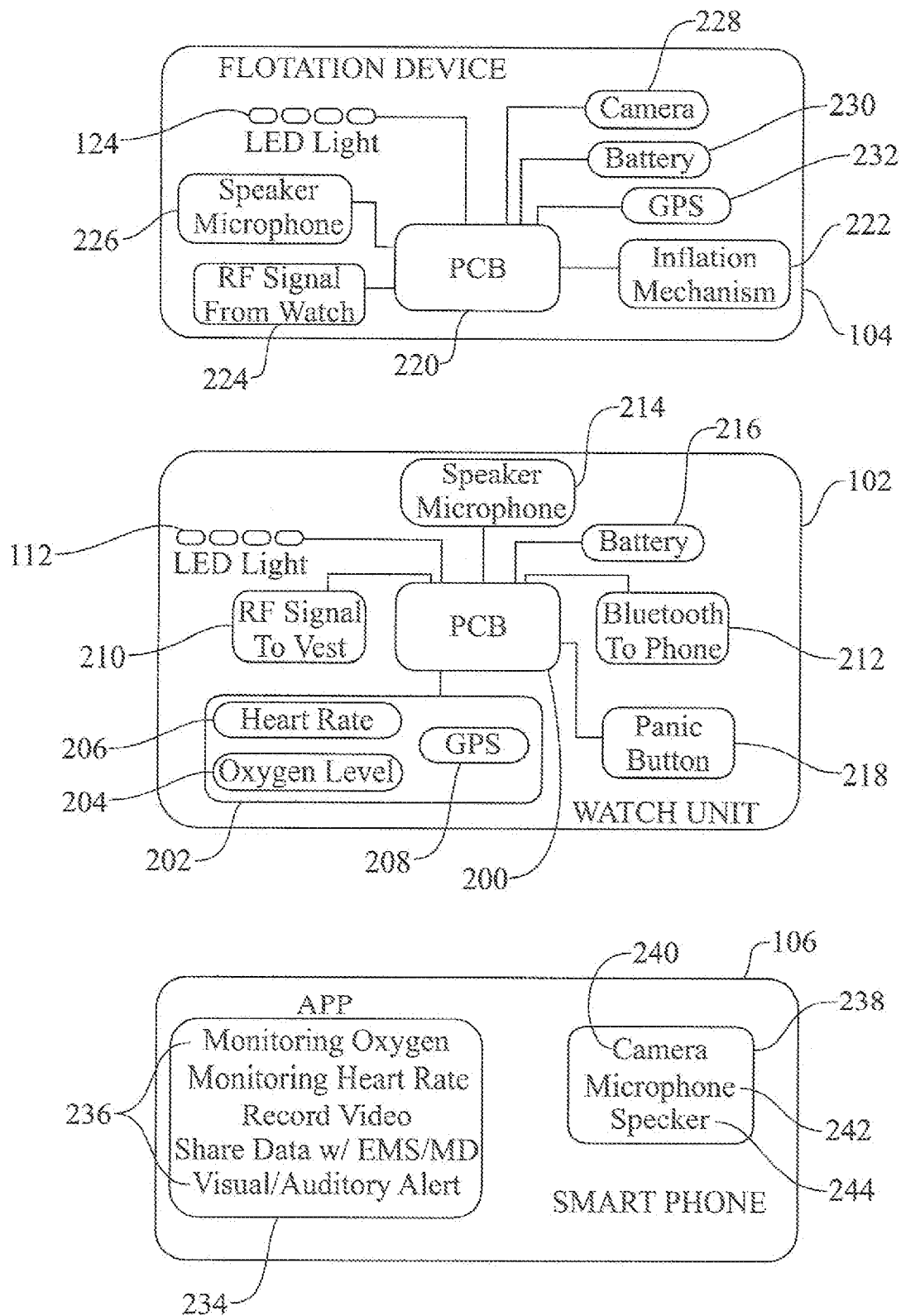


FIG. 2

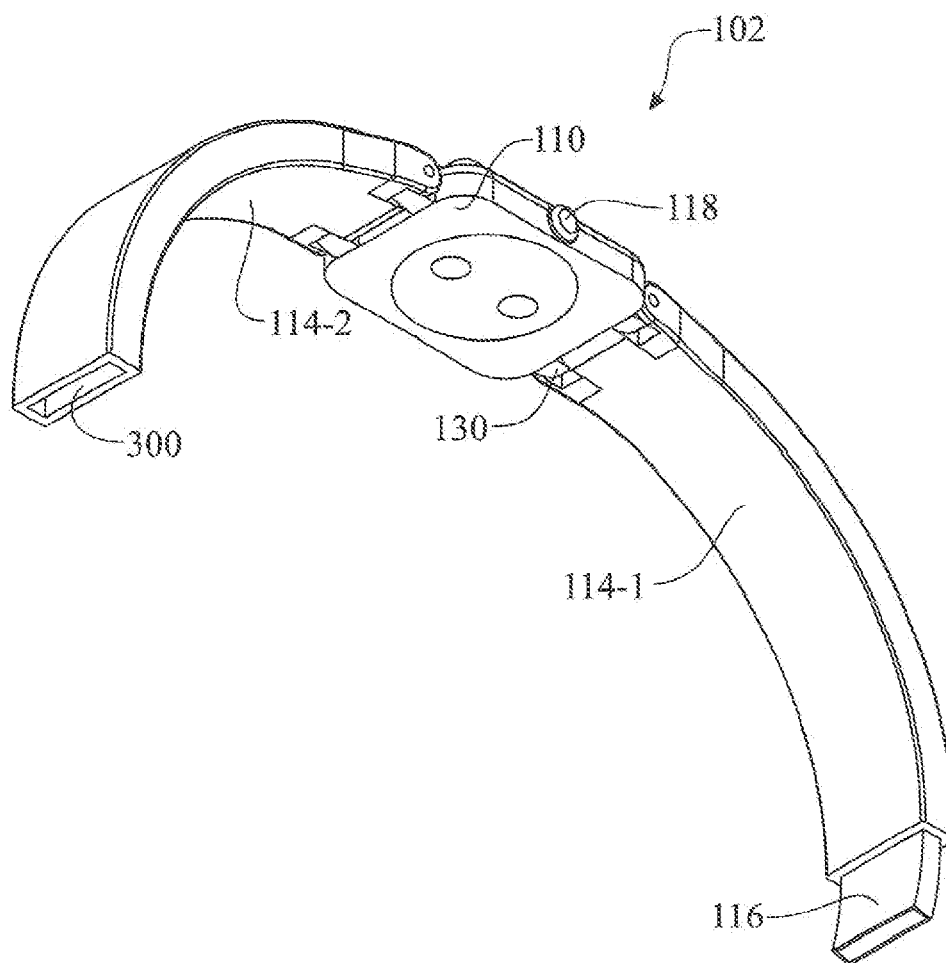


FIG. 3

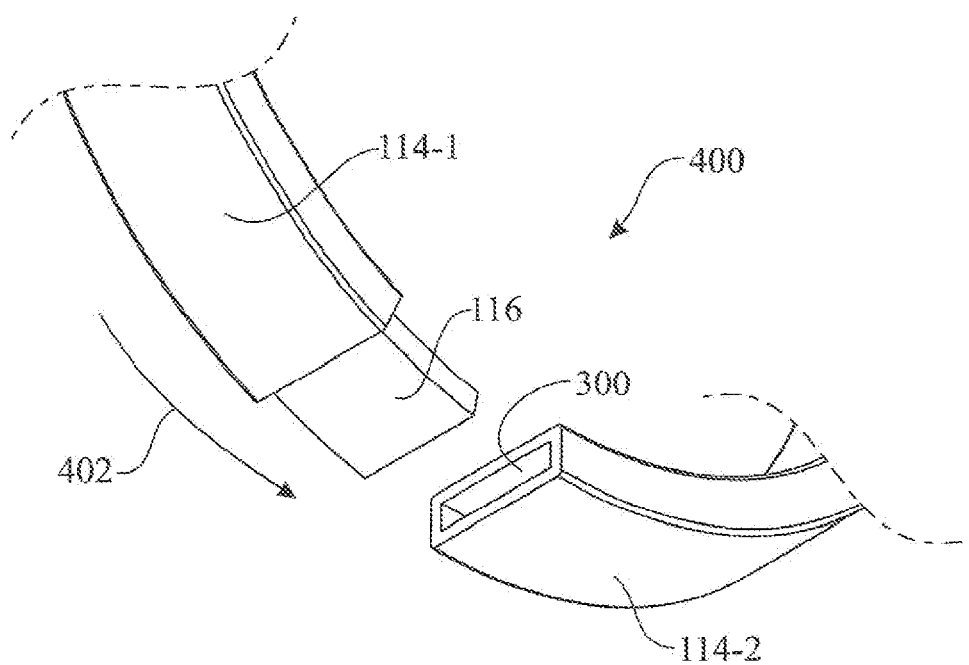


FIG. 4

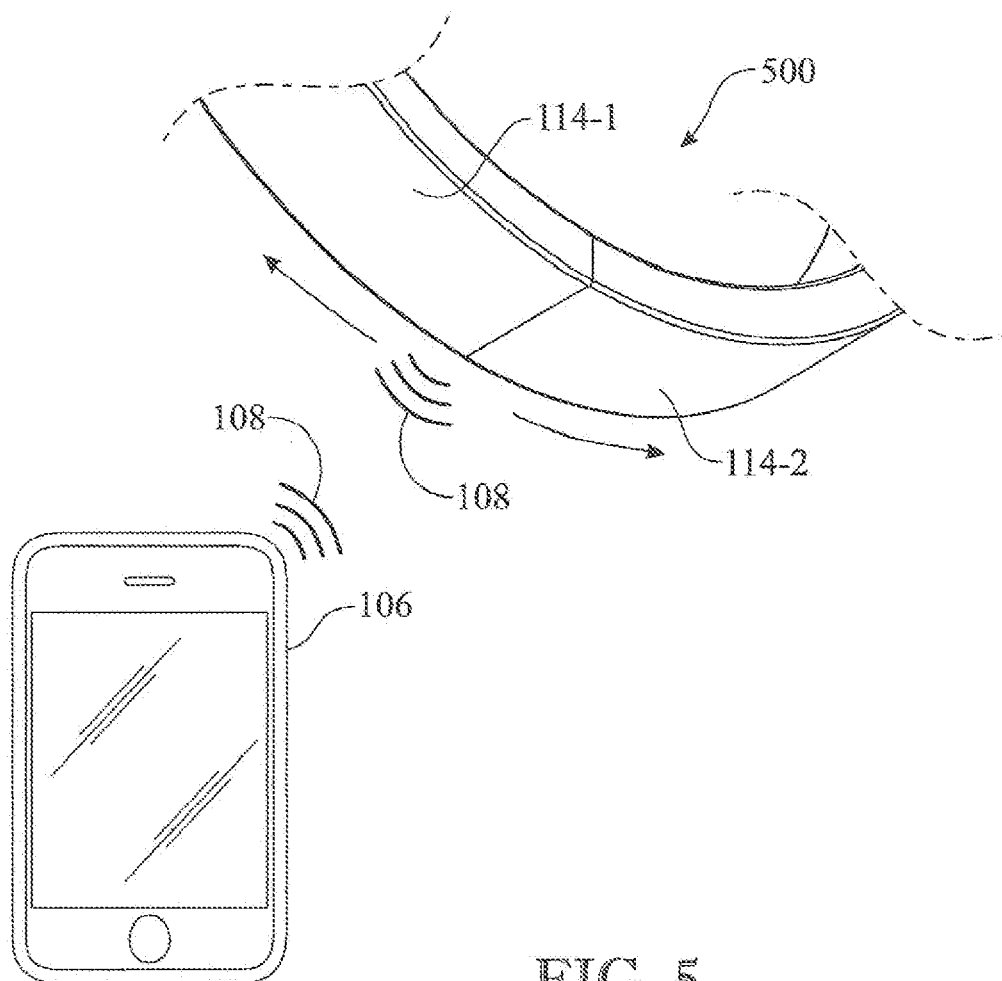


FIG. 5

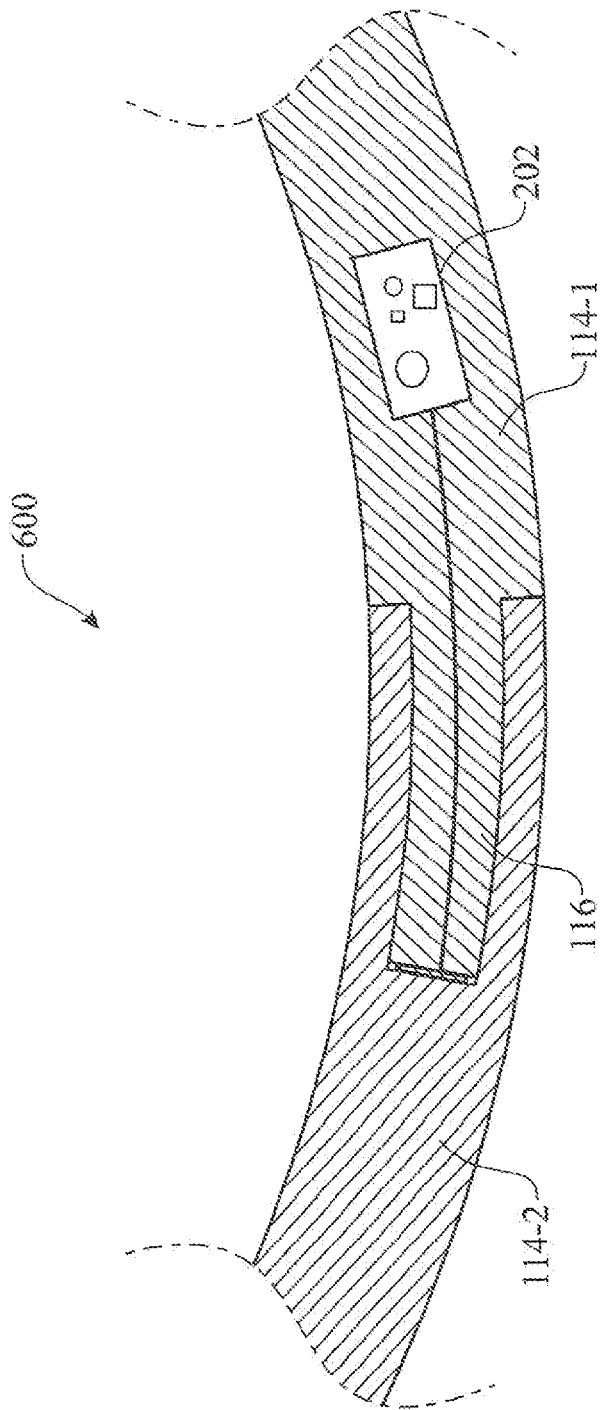
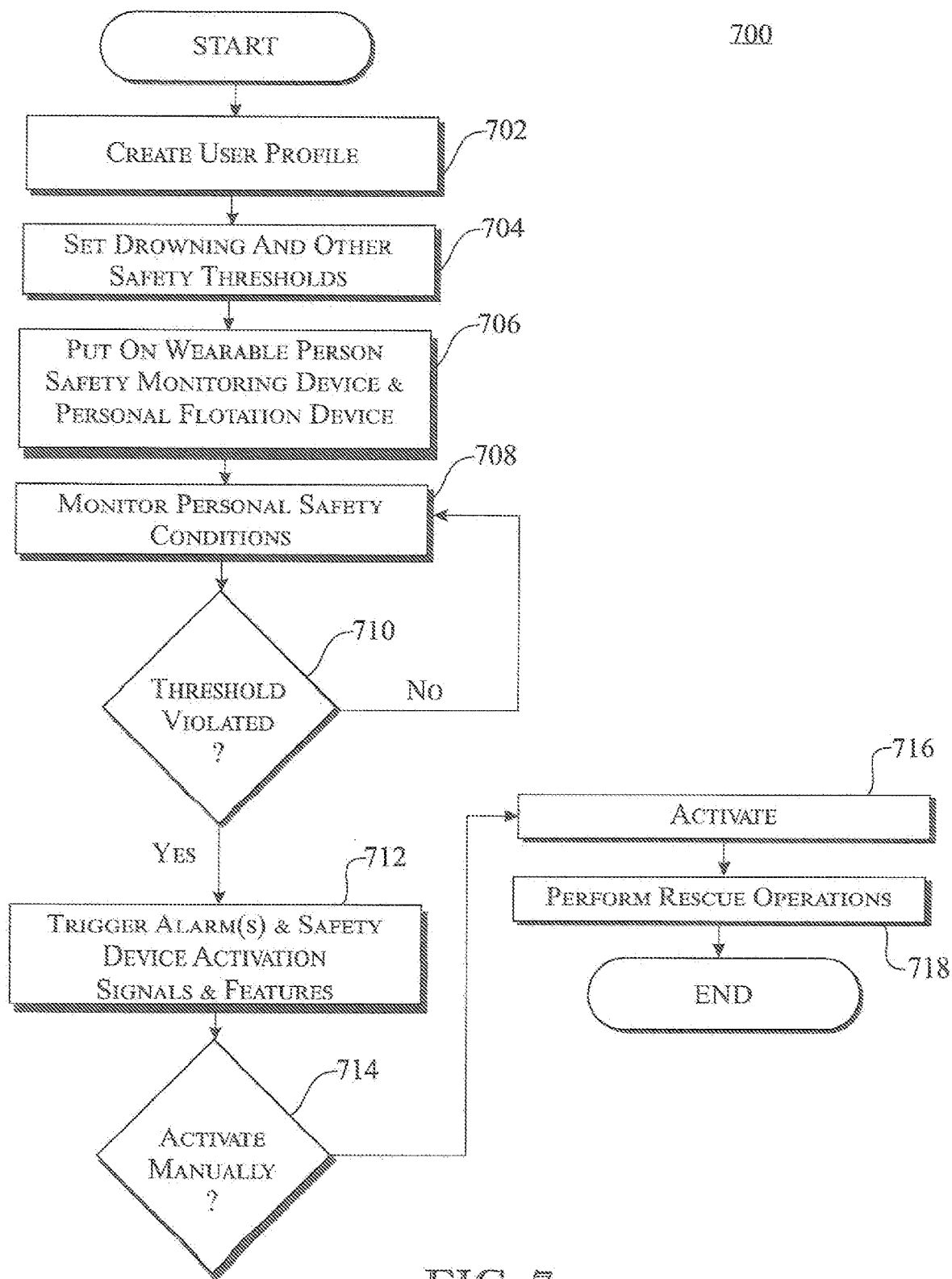


FIG. 6



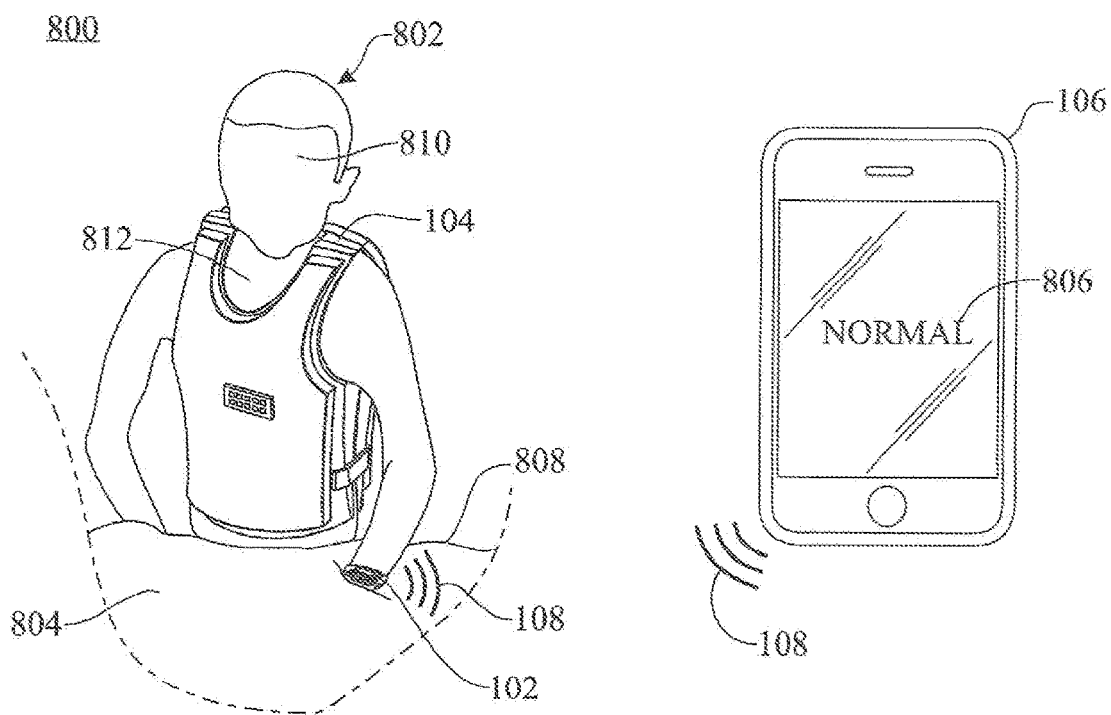


FIG. 8

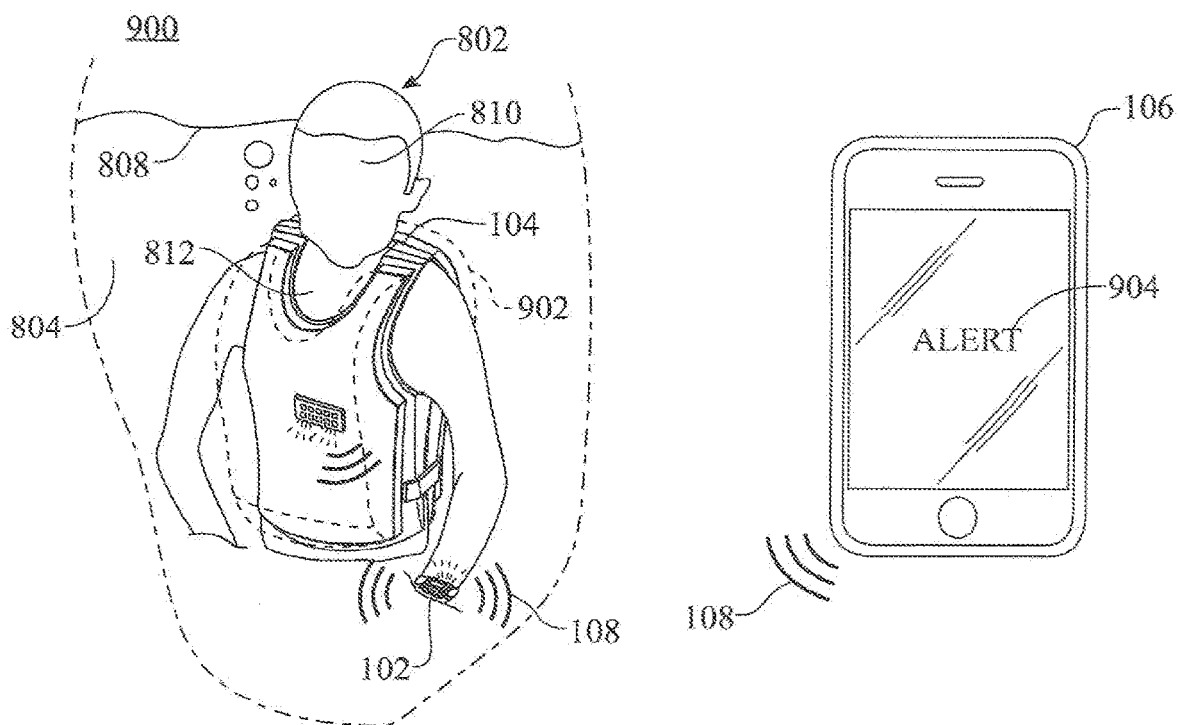


FIG. 9

Fig. 10

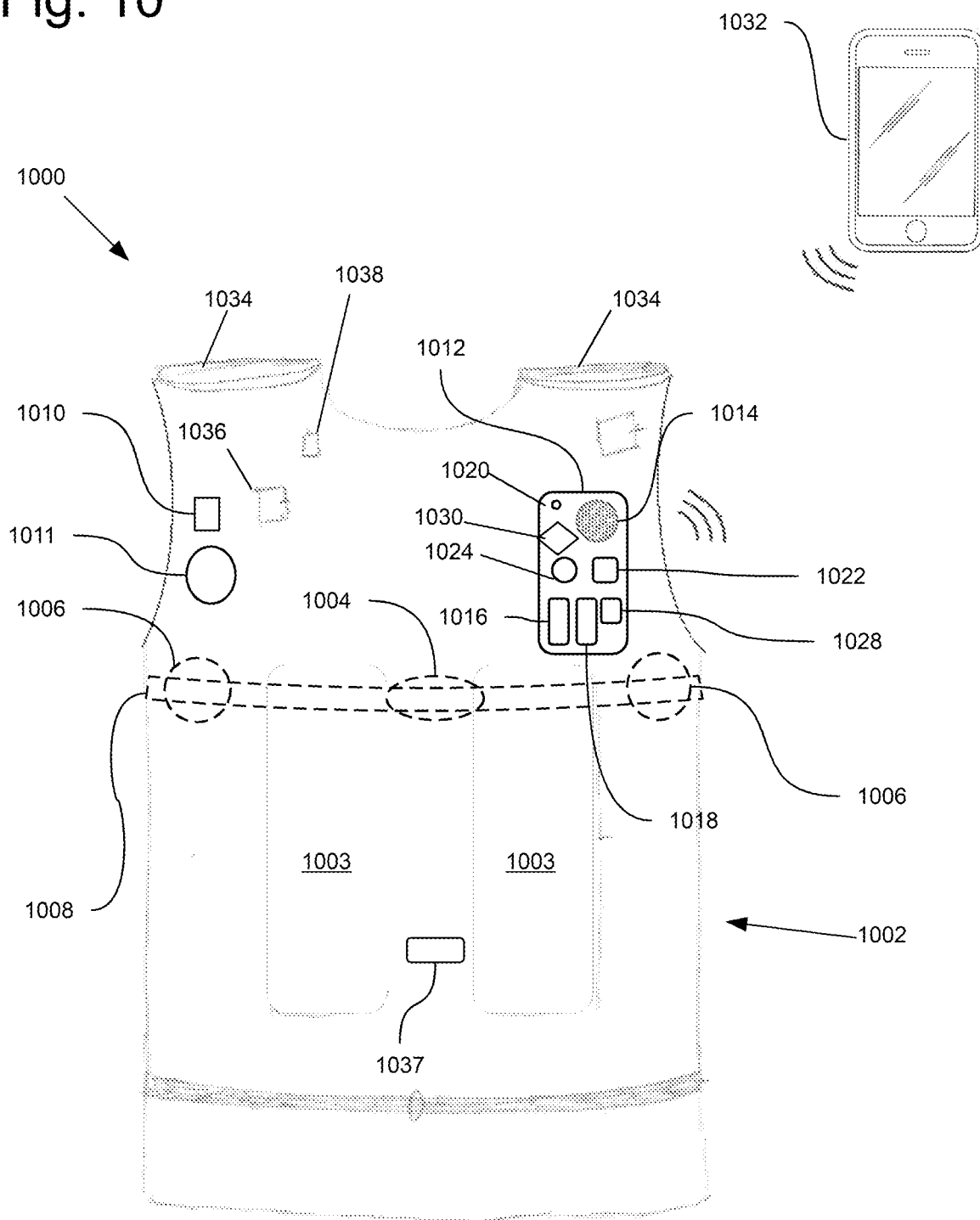


Fig. 11

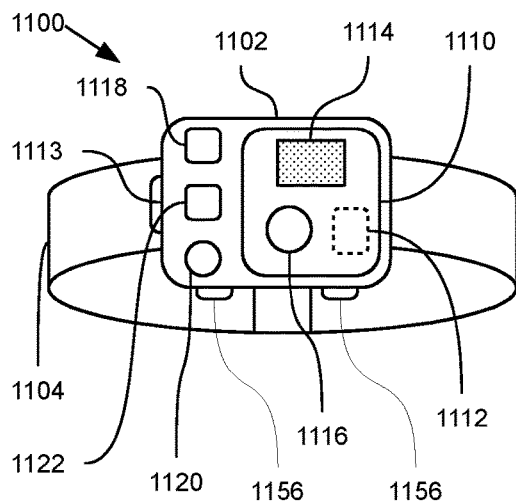


Fig. 12

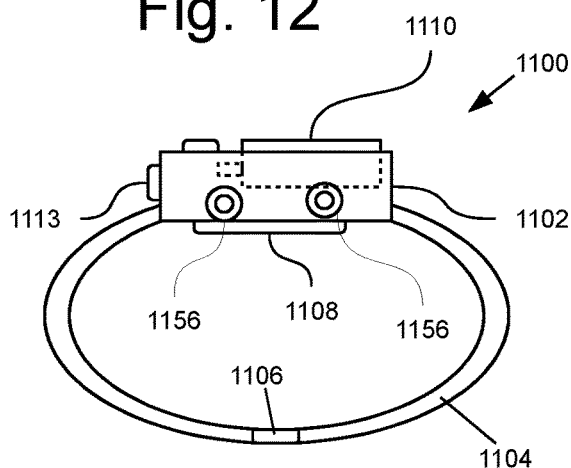


Fig. 13

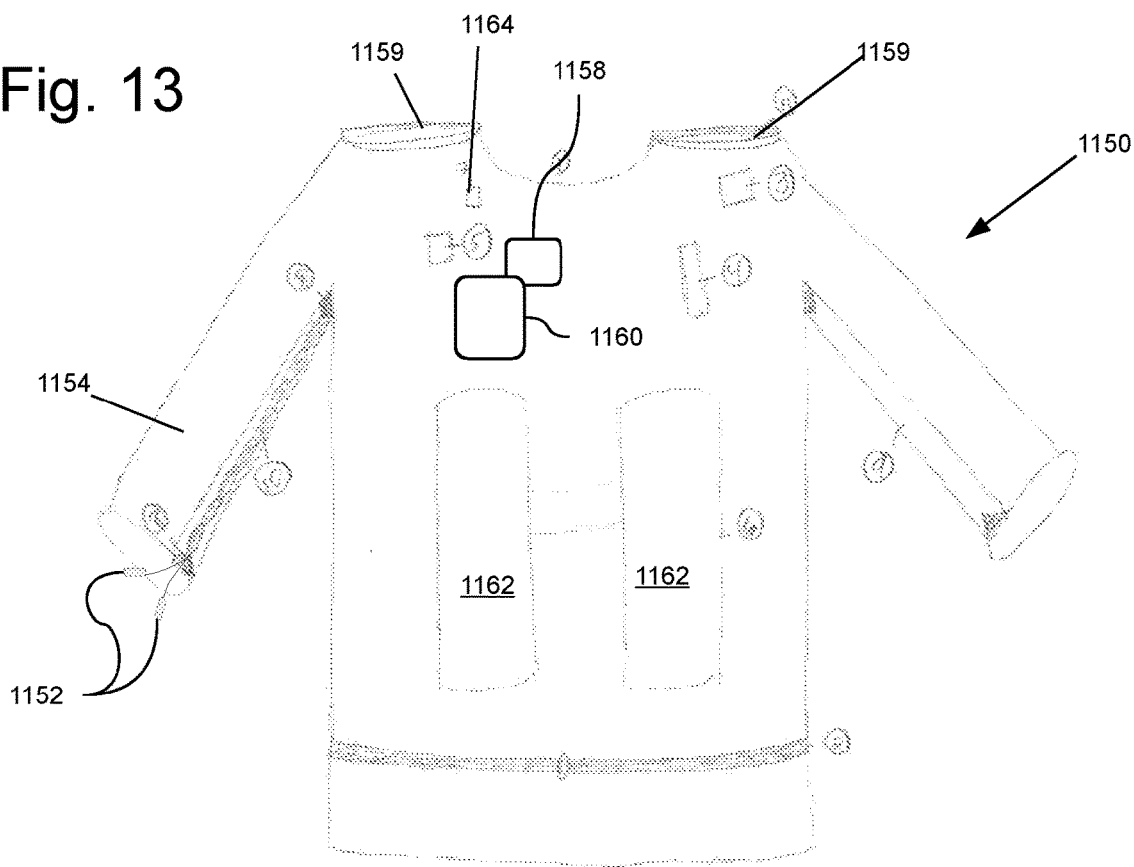


Fig. 14

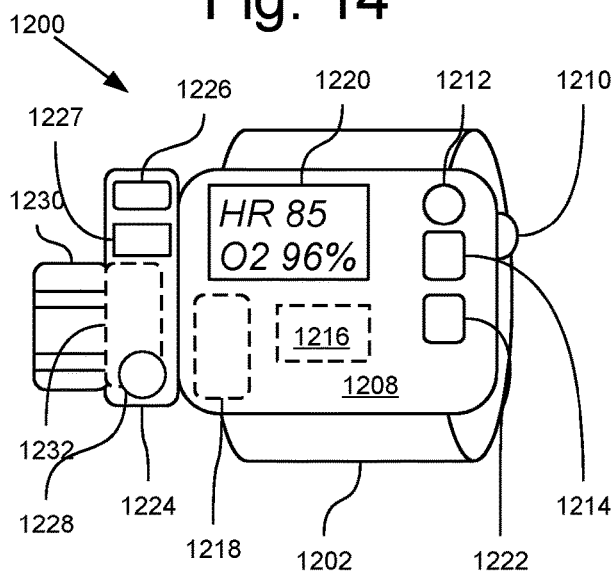


Fig. 15

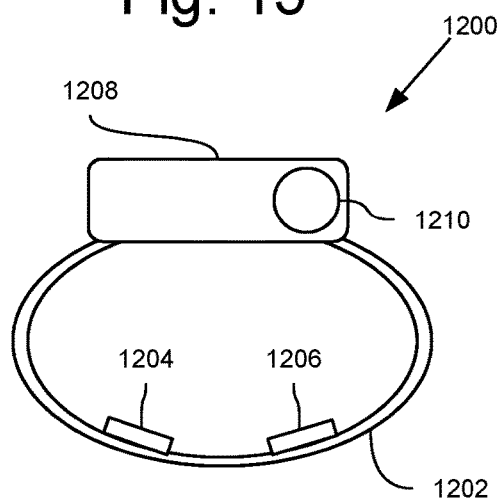


Fig. 16

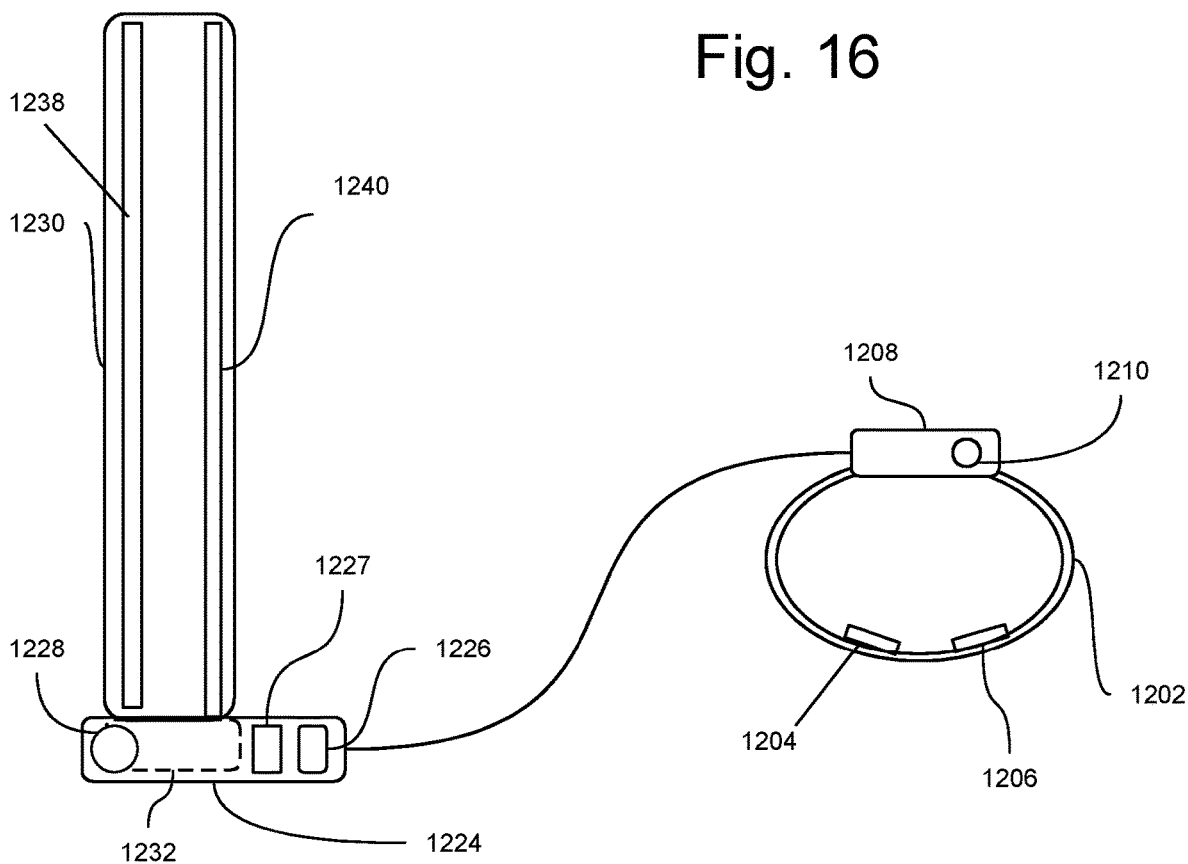


Fig. 17

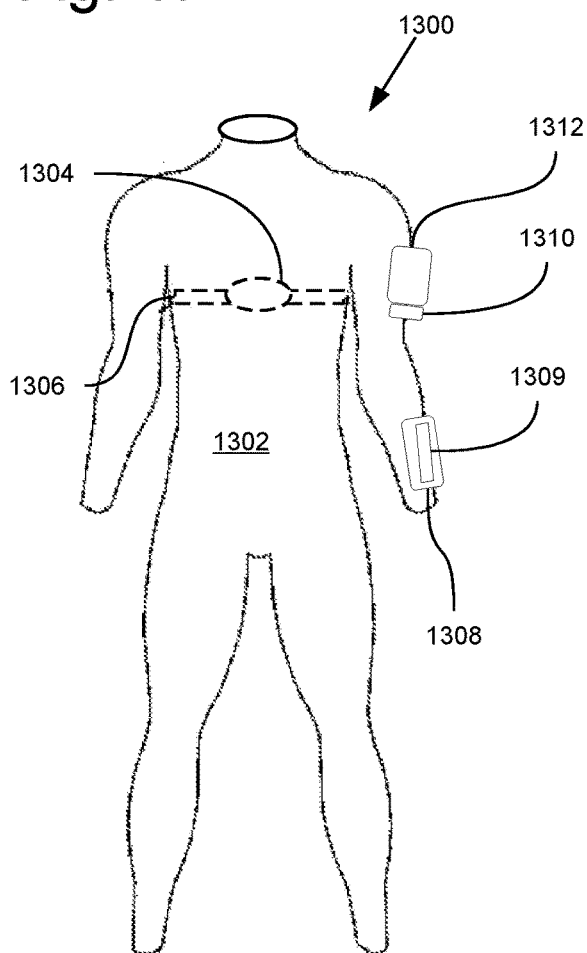


Fig. 18

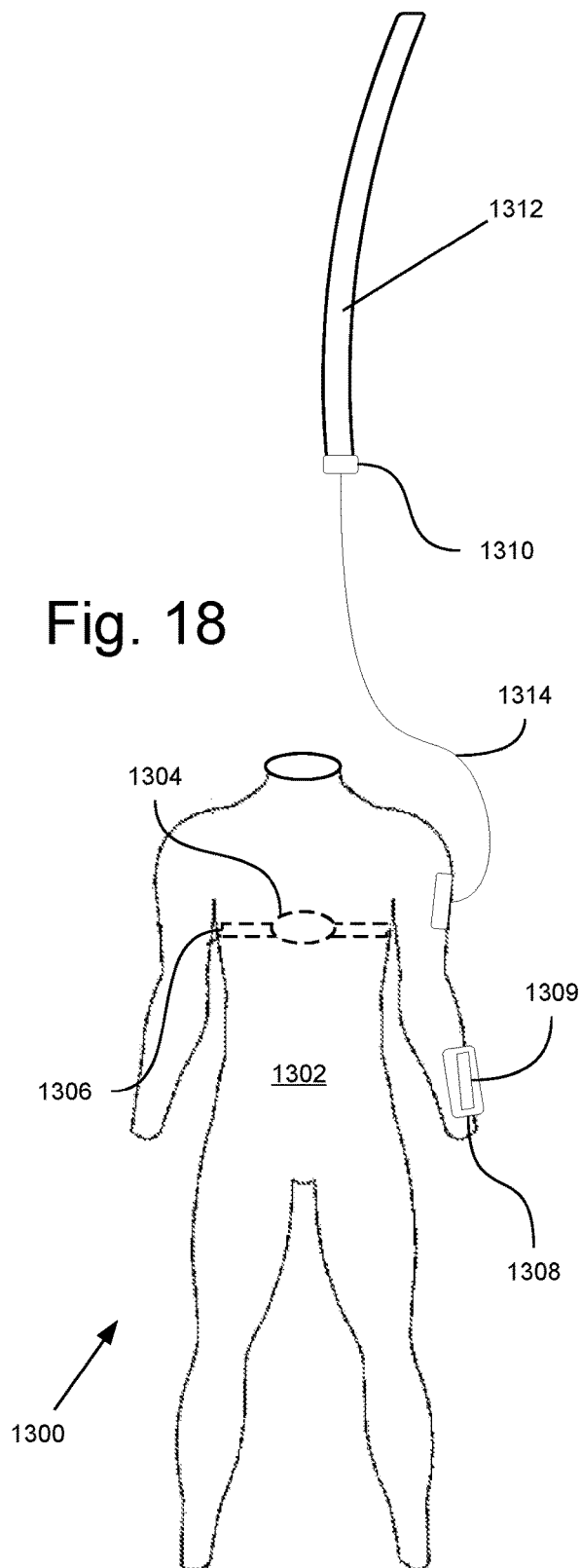
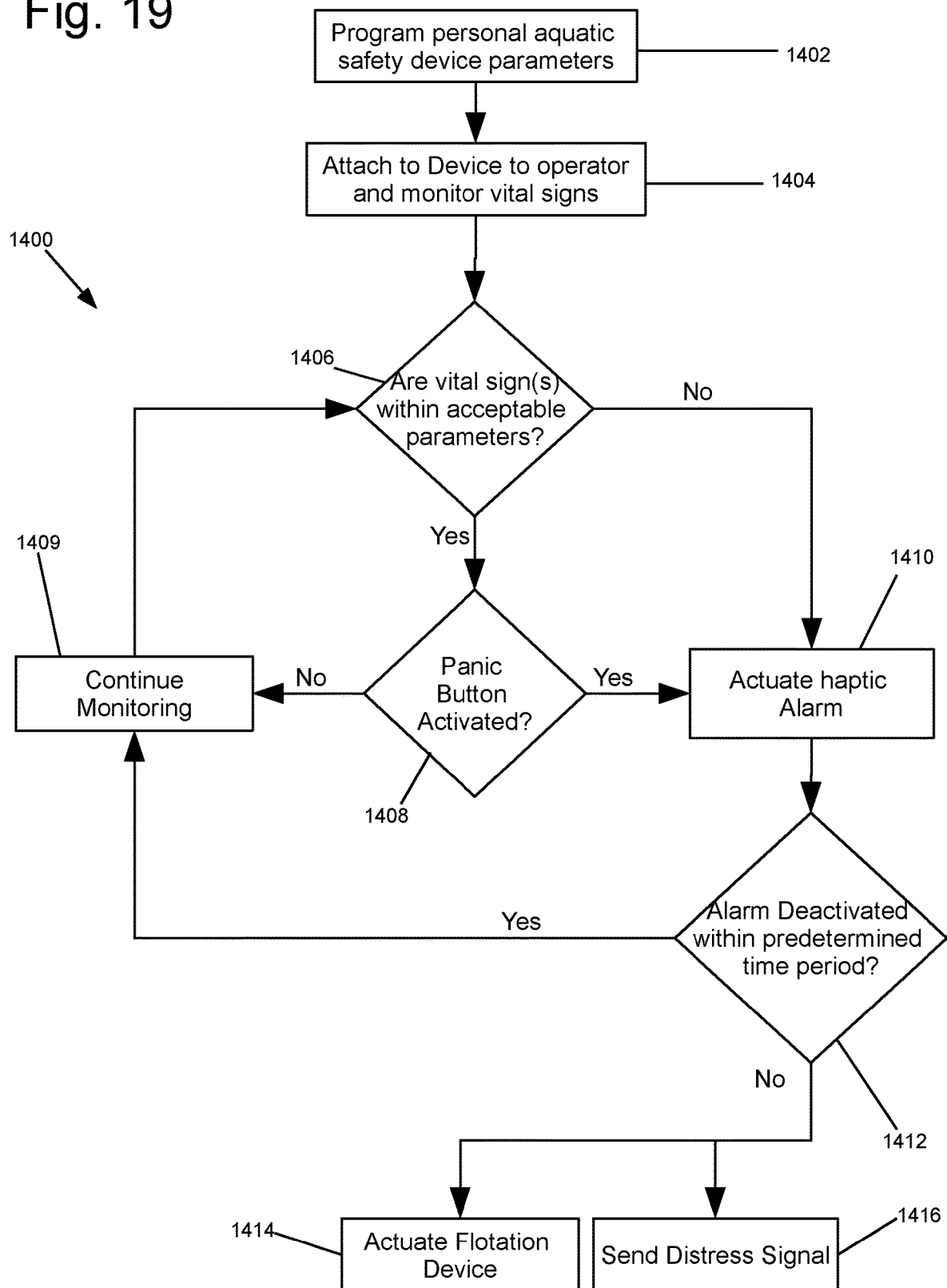


Fig. 19



PERSONAL AQUATIC SAFETY DEVICE**CROSS-REFERENCE TO RELATED APPLICATIONS**

[0001] This application claims priority to U.S. Provisional Application Ser. No. 63/043,925 filed on Jun. 25, 2020, the contents of which are hereby incorporated in their entirety.

STATEMENT REGARDING FEDERALLY SPONSORED RESEARCH OR DEVELOPMENT

[0002] Not Applicable.

NAMES OF PARTIES TO A JOINT RESEARCH AGREEMENT

[0003] Not Applicable

REFERENCE TO SEQUENCE LISTING, A TABLE, OR A COMPUTER PROGRAM LISTING APPENDIX SUBMITTED ON A COMPACT DISC AND INCORPORATION-BY-REFERENCE OF THE MATERIAL

[0004] Not Applicable.

COPYRIGHT NOTICE

[0005] Not Applicable

BACKGROUND OF THE INVENTION**Field of the Invention**

[0006] The present invention relates to a personal aquatic safety system. More particularly, the invention relates to devices and methods for monitoring a wearer's vital signs and generating alarms and distress alert signals when the wearer is in distress and integrated flotation device.

Description of the Related Art

[0007] Swimming is a widespread and popular aquatic activity enjoyed by people of all ages and at all times of the year. Millions of adults and children use public and private swimming pools and travel to beaches to also enjoy ocean swimming and recreation activities. Competitive swimming introduces young children to early athletic competition opportunities which they can continue through college and even Olympic competition for a select few. The travel and leisure markets are replete with destinations that individuals and families choose to vacation at due to their recreational swimming opportunities whether through exotic swimming pool installations or scenic and natural beaches. Further, thousands of persons enjoy boating, jet skiing, canoeing, kayaking, surfing and other activities that involve using a vessel or other article on a body of water.

[0008] Unfortunately, it is also generally known that large numbers of individuals fall victim to death or serious injury due to drowning every year because they suffered an emergency situation in a body of water. Swimming dangers exist in numerous places, for example, swimming pools (public and private), oceans, lakes, rivers and ponds. Indeed, accidental drowning during swimming causes the death of thousands of people each year and occurs among both experienced and inexperienced swimmers. Many factors can contribute to accidental drownings, including inexperience,

lack of supervision, fatigue, a sudden medical condition (e.g., seizure, heart attack, hypoglycaemia-low blood sugar, etc.) and hypothermia. Also, drownings may occur due to horseplay, undertaking dangerous stunts, drunkenness or other impairments.

[0009] In a number of situations, a rescue may have been possible if the person in distress was observed by another person(s) and an immediate rescue action taken either by an on-site lifeguard or other rescue teams. For example, in many facilities such as public pools, beaches, lakes and the like, trained lifeguards are employed to supervise and prevent drownings or other injuries by saving individuals in distress. Nevertheless, even with lifeguards on duty drownings still occur every year. To be sure, a wide variety of safety devices are marketed to prevent drownings such as life jackets, so-called "floaties", flotation belts, swimming rings and the like. However, notwithstanding the availability of such safety devices the incidence of drownings remains a systemic issue. Furthermore, it is not always easy to discern whether a swimmer is experiencing trauma, having difficulty swimming or is experience one or more contributing factors to drowning.

[0010] SCUBA diving is another aquatic activity enjoyed regularly by thousands of people every year. By its nature, SCUBA diving is inherently substantially more dangerous than regular swimming. Unless very expensive, uncommon SCUBA equipment is used, SCUBA divers cannot communicate with voice, and instead rely on hand and body signals. When a SCUBA diver is in distress, they are often unable to communicate their distress. Experienced SCUBA divers are trained to monitor their fellow divers and notice telltale signs of distress. However, divers are easily separated. Even when fellow divers do notice a diver in distress, it is often very difficult to tell the nature and extent of the distress being experienced. Numerous other aquatic activities, such as kayaking, rafting and fishing often involve partial or total submersion in water and can themselves be dangerous.

[0011] Animals, in addition to humans, can be at risk in aquatic situations. For example, older dogs or cats who have lost sight are at risk of inadvertently falling into a backyard pool, pond, or stream. Horses and larger animals crossing rivers may also get carried away and become endangered. Even large inanimate objects may be lost or damaged if they fall into a body of water.

[0012] The above-described deficiencies of today's systems are merely intended to provide an overview of some of the problems of conventional systems, and are not intended to be exhaustive. Other problems with the state of the art and corresponding benefits of some of the various non-limiting embodiments may become further apparent upon review of the following detailed description.

[0013] In view of the foregoing, it is desirable to provide devices and methods that allow for early and accurate detection of physical distress in persons engaged in aquatic activities.

BRIEF SUMMARY OF THE INVENTION

[0014] Disclosed is a personal aquatic safety device that includes at least one vital sign monitor, such as a heart rate monitor and an oxygen level monitor, a programmable microcontroller, and at least one alarm device. An alarm deactivation button may be activated to turn off the alarms in the event of a false reading by the vital sign monitors. The device also includes an inflatable flotation device and a

wireless transmitter. The microcontroller monitors the wearer's vital signs and actuates an alarm when the wearer's vital signs fall outside predetermined acceptable values. The microcontroller can also actuate a flotation device and a transmitter to send a distress signal transmitter.

[0015] The personal aquatic safety device may also include a panic button that, when activated, actuates the flotation device and actuates the transmitter to send a distress signal transmitter. A GPS module may also be included to provide the location of a wearer in distress.

[0016] The personal aquatic safety device may be integrated with a flotation device such as an inflatable vest, which may be inflated using a CO₂ canister, or optionally a manual blow tube. The personal aquatic safety device may also include a depth gauge and/or a sensor that detects when the aquatic personal safety device is submerged.

[0017] The flotation device and wireless distress signal transmitter may be housed within a deployable tracker, that, upon receiving a signal from the microcontroller, detaches from the aquatic safety device, actuates the flotation system, and transmits a wireless distress signal. The deployable tracker may or may not be communicatively connected to the safety device via a cord, and may be integrated into a scuba diving suit.

[0018] The personal aquatic safety system disclosed herein works on land and water, and in any type of water, e.g. fresh water, salt water, swimming pools and bathtubs.

[0019] It is therefore an object of the present invention to provide a system for rapidly detecting when a person in an aquatic situation is experiencing physical distress and to rapidly signal and alarm and alert others of the wearer's distress.

[0020] These and other objects and advantages of the present invention will become apparent from a reading of the attached specification and appended claims. There has thus been outlined, rather broadly, the more important features of the invention in order that the detailed description thereof that follows may be better understood, and in order that the present contribution to the art may be better appreciated. There are features of the invention that will be described hereinafter and which will form the subject matter of the claims appended hereto.

BRIEF DESCRIPTION OF THE DRAWINGS

[0021] A more complete understanding of the present invention, and the attendant advantages and features thereof, will be more readily understood by reference to the following detailed description when considered in conjunction with the accompanying drawings wherein:

[0022] FIG. 1 presents a perspective view of a personal safety system for facilitating drowning prevention or other cases of accidents due to a deleterious physiologic indicator in accordance with a first embodiment of the invention.

[0023] FIG. 2 presents an illustrative configuration of the wearable personal safety device, the personal flotation device and the communications device of the personal safety system of FIG. 1 in accordance with an embodiment.

[0024] FIG. 3 presents a perspective view of the underside of the wearable personal safety device of FIG. 2 in accordance with an embodiment.

[0025] FIGS. 4 and 5 presents an illustrative configuration for utilizing the latching mechanism of the wearable personal safety device to communicatively couple with the communications device in accordance with an embodiment.

[0026] FIG. 6 presents a cross-sectional view of the latching mechanism of the wearable personal safety device of FIG. 5 in the locked position in accordance with an embodiment.

[0027] FIG. 7 presents a flowchart of illustrative operations for facilitating drowning prevention or other cases of accidents due to a deleterious physiologic indicator using the personal safety system of FIG. 1 in accordance with an embodiment.

[0028] FIGS. 8 and 9 presents illustrative scenarios of a person utilizing the person safety system of FIG. 1 in a normal scenario and a under duress scenario, respectively, in accordance with an embodiment under normal conditions.

[0029] FIG. 10 shows an alternative embodiment of a personal aquatic safety device in accordance with the principles of the invention;

[0030] FIG. 11 shows a top view of another alternative embodiment of a personal aquatic safety device in accordance with principles of the invention;

[0031] FIG. 12 is a side elevation view of another alternative embodiment of a personal aquatic safety device in accordance with principles of the invention;

[0032] FIG. 13 is a front view of a flotation device for use in connection with the alternative embodiment of a personal aquatic safety device shown in FIGS. 11 and 12 in accordance with principles of the invention;

[0033] FIG. 14 is a top view of another alternative embodiment of a personal aquatic safety device in accordance with principles of the invention;

[0034] FIG. 15 is a side elevation view of another alternative embodiment of a personal aquatic safety device with a deployable tracker in accordance with principles of the inventions;

[0035] FIG. 16 is a side elevation view of another alternative embodiment of a personal aquatic safety device with a deployable tracker having a flotation device deployed in accordance with principles of the invention;

[0036] FIG. 17 is another alternative embodiment of a personal aquatic safety device with a deployable tracker in accordance with principles of the invention;

[0037] FIG. 18 is another alternative embodiment of a personal aquatic safety device with a deployable tracker having a flotation device deployed in accordance with principles of the invention;

[0038] FIG. 19 is a flowchart for use with a personal aquatic safety system in accordance with principles of the invention.

DETAILED DESCRIPTION

[0039] The specific devices, processes, systems and methods illustrated in the attached drawings, and described in the following specification, are intended to serve only as exemplary embodiments of the inventive concepts defined in the claims. The invention is not limited in its application to the details of construction or to the arrangements of the components set forth in the following description and/or illustrated in the drawings. The invention is capable of other embodiments and of being practiced and carried out in various ways. Also, it is to be understood that the phraseology and terminology employed herein are for the purpose of description and should not be regarded as limiting.

[0040] The disclosed subject matter is described with reference to the drawings, wherein like reference numerals are used to refer to like elements throughout. In the follow-

ing description, for purposes of explanation, numerous specific details are set forth in order to provide a thorough understanding of the various embodiments of the subject disclosure. It may be evident, however, that the disclosed subject matter may be practiced without these specific details. In other instances, well-known structures and devices may be shown in block diagram form in order to facilitate describing the various embodiments herein. Various embodiments of the disclosure could also include permutations of the various elements recited in the claims as if each dependent claim was a multiple dependent claim incorporating the limitations of each of the preceding dependent claims as well as the independent claims. Unless explicitly stated otherwise, such permutations are expressly within the scope of this disclosure.

[0041] Unless otherwise indicated, all numbers expressing quantities of ingredients, dimensions reaction conditions and so forth used in the specification and claims are to be understood as being modified in all instances by the term “about”. The term “a” or “an” as used herein means “at least one” unless specified otherwise. In this specification and the claims, the use of the singular includes the plural unless specifically stated otherwise. In addition, use of “or” means “and/or” unless stated otherwise. Moreover, the use of the term “including”, as well as other forms, such as “includes” and “included”, is not limiting. Also, terms such as “element” or “component” encompass both elements and components comprising one unit and elements and components that comprise more than one unit unless specifically stated otherwise. As used herein, the term “alarm” may refer to the alarm itself, or to the physical component that generates the alarm. For example, “audio alarm” may refer to the alarm itself, or to both the audio alarm and the speaker emitting it. “Visual alarm” is often used to refer to the light system that generates the visual alarm, but may also be used to refer to the actual light emitted as an alarm. Actual usage should be clear from the context. “Physiological indicators” refers to parameters used to measure biological activities of living organisms. Non-limiting examples include blood oxygen level, heart rate, pulse, blood pressure, carbon dioxide levels, respiratory rate, EKG, EEG, cerebral oxygen, and arterial blood gas.

[0042] For ease of understanding, illustrative examples are used to describe embodiments of the invention. These should not be regarded as limiting. Some examples found herein include references to humans. Throughout the specification the systems, devices and methods of the invention are describe in reference to use with a human. However, those skilled in the art will appreciate that the described devices and methods are suitable for use with animals and even inanimate objects. The invention may be used with older pets who no longer see well and may accidentally fall into a body of water. Even animals that are not in any way disabled may nonetheless find themselves in distress in a body of water and in need of assistance. Bluetooth® technology is referenced as a form of wireless communication. However, those skilled in the art will appreciate that there are many other suitable forms of wireless communication, having different strengths, ranges and qualities. The invention may be used with any suitable, practical form of wireless communication. For example, Bluetooth® may be replaced with wi-fi and wireless routers, radio frequency, other near field technologies, and acoustic technologies. The use ultrasound acoustic signals may be used to send trans-

missions through the water in place of or in addition to more common wireless technologies.

[0043] A personal aquatic safety system as described herein includes one or more monitors for detecting various vital signs or other physiological indicators, such as for example blood oxygen levels, heart rate, pulse, blood pressure, carbon dioxide levels, respiratory rate, EKG, cerebral oxygen, arterial blood gas or other parameters that may be monitored using sensors applied to the body.

[0044] The system also includes a microcontroller (i.e. a compact integrated circuit) or other programmable devices store predetermined acceptable parameters for the physiological indicators being monitored. In addition to storing acceptable parameters, the programmable device may also either directly include or be in communication with a GPS module, an accelerometer, a water sensor, a depth gauge, a transmitter, and the physiological indicator monitors (also known as vital sign monitors, and generally referred to as monitors herein).

[0045] The system also preferably includes one or more alarms that generate a signal likely to attract attention in the immediate vicinity of the person (or animal or object) such as for example an audio alarm, a visual alarm and/or a haptic alarm. An exemplary audio alarm would be a relatively loud emission from a speaker integrated into the aquatic safety system. Those skilled in the art will appreciate that such audio alarms are commonly used in a variety of settings and may emit a single loud tone, or a pattern or range of tones, which may be continuous or consist of several short repeating sequences, or anything in between. An exemplary visual alarm may be one or more bright lights which emit a continuous or flashing pattern. For example, a bright, quickly flashing red light is often used with alarms. A haptic alarm is typically intended to only notify a person in contact with the haptic device. A haptic alarm of the personal aquatic safety system may be used to alert a person who's physiological condition is being monitored that one or more parameters have fallen outside acceptable limits. The system may also include one or more haptic alarms in contact with a different individual.

[0046] The system also preferably includes a transmitter for providing wireless communication. Most common wireless communication is facilitated by electromagnetic waves, often within a range of frequencies and/or amplitudes. A transmitter for use with the personal safety system may also send acoustic signals in addition to or in place of electromagnetic signals.

[0047] The aquatic safety system also preferably includes a flotation system. The flotation system can be any mechanism for increasing positive buoyancy, thereby lifting objects attached to the flotation system to the surface and/or maintaining the object lifted at the surface of a body of water. The flotation system can be part of a garment. For example, a garment such as a shirt or vest may include one or more inflatable pockets and a means for filling the inflatable pockets. Those skilled in the art will appreciate that there are a variety of means for inflating pockets, such as for example a cartridge of carbon dioxide or other gas which can be actuated to transfer the gas from the cartridge to the inflatable pockets. Alternatively a flotation system may include one or more negative buoyancy objects (such as for example one or more weights) that can be released,

thereby increasing positive buoyancy. Those skilled in the art will appreciate that there are additional suitable flotation devices.

[0048] The aquatic safety system also may optionally include a deployable tracker. The deployable tracker is a device integrated into the aquatic safety system that can be released, causing it to float to the surface. The deployable tracker can include some or all of the other components of the safety system, for example the GPS module, one or more of the alarms, the microcontroller and the transmitter. Alternatively, the deployable tracker may include its own separate microcontroller, GPS module, and/or transmitter. Once the tracker is deployed, it may remain connected to the safety system by a cord, or be completely disconnected from the other components of the personal aquatic safety system. For a person who cannot immediately rise to the surface, a flotation device that causes the wearer to ascend is not suitable. In addition, the most common forms of wireless communication are only effective through air, not water. The deployable tracker is used to rapidly ascend to the surface in order to transmit a distress signal and emit one or more of the alarms. The deployable tracker may itself be relatively buoyant, or may be integrated with a flotation system, which may or may not be the safety system's flotation system.

[0049] When one or more of the physiological indicators measured by the device fall outside a preselected range, the microcontroller performs one or more preselected actions. It may send a distress signal through the wireless transmitter, generate one or more alarms, and/or activate the flotation system.

[0050] The personal aquatic safety system may be integrated into one or more garments or other objects to be worn. For example, the entire safety system may be integrated into a shirt, vest, dive suit and/or a device worn on the wrist. Optionally, the system may be integrated into two or more communicatively linked garments and/or devices.

[0051] Optionally, the microcontroller may activate the haptic alarm only for a short time period, for example 5 to 20 seconds prior to activating the other components. This notifies the wearer that it has detected a distress situation and is preparing to activate the transmitter, alarms and flotation device. The wearer then has the option to cancel the impending actions. This allows the wearer to prevent alarms and distress signals based on a false reading or for other reasons. The system may also include a "panic button" that allows the wearer to activate the alarms, send a distress signal, and activate the flotation device immediately.

[0052] The distress signal transmitted from the safety system may include a variety of important information regarding the wearer. For example the distress signal can include the readings from the various physiological monitors, the location of the person in distress, the amount of time the wearer has been under water, the depth of the wearer, the identity of the wearer, and/or the rate of descent or ascent of the wearer.

[0053] The transmitted distress signal may also include instructions to generate an alarm on one or more devices. For example, an application on a mobile or other device may be actuated by the distress signal to generate audio or visual alarms and display the information included in the distress signal.

[0054] FIG. 1 shows a personal aquatic safety system 100 for facilitating drowning prevention or other cases of accidents due to a plurality of personal safety conditions such as

a deleterious physiologic changes which may lead to asphyxiation, dangerous heart rate conditions, or other distress that may be experienced by a person in an aquatic environment in accordance with a first embodiment of the invention. As shown for instance in FIG. 1, the personal safety system 100 comprises a wearable personal safety monitoring device 102 configured to monitor the plurality of personal safety conditions such as the oxygen and heart rate of the wearer (i.e., a body). The wearable personal safety monitoring device 102 further comprising (i) band 114 having a first band section 114-1 and second band section 114-2 for securing (i.e., coupling) the wearable personal safety monitoring device 102 on a portion of the wearer's body (e.g., their wrist). The band 114 having safety locking latch 116 to further facilitate securing the wearable personal safety monitoring device 102 by locking the first band section 114-1 to the second band section 114-2 by inserting the safety locking latch 116 into a slot (not shown) located within the body of the second band section 114-2 in a conventional manner and activating the safety features thereof, as will be further detailed herein below; and (ii) monitor 110 comprising a housing 132 and communicatively coupled with personal flotation device 104 illustratively through wireless communications links 108 using well-known Bluetooth® technology, and further comprising a variety of monitoring elements such as LEDs 112 for illumination, a microphone (not shown) and a speaker (not shown) for providing visual and audible features and panic button 118. The first band section 114-1 and the second band section 114-2 being affixed to the monitor 110 in a conventional manner using a plurality latching pins 130. As will be appreciated, while the wearable personal safety monitoring device 102 shown in FIG. 1 is configured as a well-known smart watch any number of wearable devices and other configurations may be utilized with the principles of the disclosed embodiments herein. The safety lock may be configured to only be released upon receiving a release command through the transmitter.

[0055] The personal safety system 100 further comprises a personal flotation device 104 configured to be communicatively coupled, illustratively through wireless communications links 108 using well-known Bluetooth® technology, for example, with the wearable personal safety monitoring device 102. The personal flotation device 104 further comprising (i) front vest area 120 that when worn by a person will be aligned with the person's face area when the person using the personal flotation device 104 pulls the personal flotation device 104 over their head in a conventional manner and corresponding back vest area 128 aligned with and proximate to the person's back when worn in such conventional manner. The front vest area 120 and the back vest area 128 may be fabricated from well-known flotation materials that will illuminate (glow) under dark light conditions or when subject to a direct light in a well-known manner; (ii) latch 126 for securing the front vest area 120 to the back vest area 128 when worn in such conventional manner. The latch 26 may also be fabricated for childproofing that will prevent a child from inadvertently unlatching the front vest area 120 from the back vest area 128; and (iii) vest monitor 122 which comprises a variety of monitoring elements such as LEDs 124 for illumination, a microphone (not shown) and a speaker (not shown) for providing visual and audible features. The vest monitor 122 being communicatively coupled with the wearable personal safety moni-

toring device **102** illustratively through wireless communications links **108** using well-known Bluetooth® technology.

[0056] The personal safety system **100** further comprising communications device **106** communicatively coupled with the wearable personal safety monitoring device **102** and/or the personal flotation device **104**. As will be appreciated, while the communications device **106** shown in FIG. 1 is configured as a well-known smartphone any number of communications devices that execute mobile applications may be utilized with the principles of the disclosed embodiments herein. As such, a “mobile device” in the context herein may comprise a wide variety of devices such as smartphones, laptop computers, tablets, and wearable devices, to name just a few.

[0057] In an embodiment, as will be further discussed in detail herein below, the wearable personal safety monitoring device **102** is worn by a swimmer such that the swimmer’s oxygen and heart rate levels are continually monitored to detect a potential or actual drowning situation such that the wearable personal safety monitoring device **102** transmits, using the wireless communications links **108**, a first alert signal to the personal flotation device **104** to automatically inflate thereby raising the level of the swimmer in the body of water in which the swimmer is located and transmits, using the wireless communications links **108**, and a second alert signal to the communications device **106** such that this device registers a visual and/or auditory alarm thereon in a well-known manner.

[0058] Turning our attention to FIG. 2, an illustrative configuration is shown of the wearable personal safety device **102**, the personal flotation device **104** and the communications device **106** of the personal safety system **100** of FIG. 1 in accordance with an embodiment. As shown, the wearable personal safety device **102** comprises a conventional printed circuit board (PCB) **200** for the delivery of a variety of electronic elements such as physiological and location sensor module **202**. The physiological and location sensor module **202** comprising at least oxygen level sensor **204**, heart rate sensor **206**, and global positioning system (GPS) sensor **208** for monitoring the oxygen level, heart rate and position of a person wearing the wearable personal safety device **102**, as will be discussed in greater detail herein below. The physiological and location sensor **202** is further configurable to comprise other elements such as a submersible timer, a depth sensor and/or a water pressure sensor. In this way, the wearable personal safety device **102** may be configured to measure the wearer’s depth in a body of water, a rate of submersion in the body of water and/or a time of submersion in the body of water. Illustratively, the oxygen level sensor **204** includes a pulse oximeter which is a well-known small, lightweight device for measuring blood oxygen level (in particular, measuring the saturation of oxygen carried in red blood cells) which, in accordance with the embodiment, is vital data when a swimmer is drowning in that during this physical activity energy spent and blood oxygen declines as the oxygen is consumed. Typical oxygen saturation levels are greater than 95% but if this level falls below 90% in most humans it may cause a dangerous health situation and severe (or fatal) breathing difficulties. Of course, there are a variety of reasons why different individuals may have different normal blood oxygen levels base on the individual’s overall fitness level, health issues, and/or the geographic/altitude region where the individual resides.

[0059] Panic button module **218** delivers the electronic functionality for the panic button **118** which can be used by the wearer of the wearable personal safety device **102** in the event of an emergency situation such as drowning. Radio frequency (RF) communications module **210** facilitates the transmission of RF signals in a well-known manner from the wearable personal safety device **102** to other devices (e.g., the personal flotation device **104**) and in a similar well-known fashion Bluetooth® communications module **212** facilitates Bluetooth® wireless communications between the wearable personal safety device **102** and other devices (e.g., the communications device **106**). Input/output module **214** provides speaker and microphone audio capabilities and battery **216** (e.g., a NiCad battery) provides a power supply to the wearable personal safety device **102**, both in well-known fashion. LEDs **112** will illuminate and providing a visual warning in the event the wearer of the wearable personal safety device **102** is drowning, as will be further detailed herein below.

[0060] As shown, the personal flotation device **104** comprises a conventional printed circuit board (PCB) **220** for the delivery of a variety of electronic elements such as RF communications module **224** facilitates the reception of RF signals in a well-known manner from the wearable personal safety device **102** and from other devices and in a similar well-known fashion GPS module **232** facilitates the delivery of location services such that the precise location of the personal flotation device **104** can be determined at any time (e.g., in an emergency drowning of the wearer of the personal flotation device **104**) and transmitted to other device (e.g., the communication device **106**). Input/output module **226** provides speaker and microphone audio capabilities and battery **230** (e.g., a NiCad battery) provides a power supply to the personal flotation device **104**, both in well understood fashion. Camera module **228** provides an individual camera to provide either a live video feed or capture standard photographs and the transmission thereof from the personal flotation device **104** to other devices (e.g., the communications device **106**) that can be used during a state of emergency (e.g., drowning). LEDs **124** will illuminate and providing a visual warning in the event the wearer of the personal flotation device **104** is drowning, as will be further detailed herein below. In addition, inflation module **222** will activate when the personal flotation device **104** detects that the wearer of the personal flotation device **104** is experiencing a drowning or temporary submersion issue in the body of water they are located and will activate to inflate to provide additional buoyancy to the wearer to mitigate the drowning or submersion conditions, as will be further detailed herein below. In this way, when activated the inflation module **104** will establish a safer position for the wearer such as floating on their back or head-up position thereby attempting to mitigate the drowning conditions. It will be noted that while the personal flotation device **104** in the above-detailed embodiment is in a vest form there exist many other types of configurations that are consistent with the principles of the disclosed embodiments such as swim shirts, a dry/wet suit or a band wearable across the torso, to name just a few.

[0061] As further shown in FIG. 2, the communication device **106** is configured as a well-known smartphone in accordance with an embodiment. The communications device **106** includes a processor (now shown), memory (not shown), and application (APP) **234** that is configured for

execution as a mobile application program. Upon launching and executing the APP 234, the user activates and executes all operations that are necessary or desired to facilitate drowning prevention or other cases of accidents due to asphyxiation or heart rate conditions (and other personal safety conditions) in accordance with the embodiment, and as further detailed herein below. Illustratively, the APP 234 provides, upon execution, a plurality of services 236 including, but not limited to, monitoring oxygen level, monitoring heart rate, recording video, sharing or transmitting data (e.g., to medical or emergency services (EMS) personnel) and activating visual and auditory alerts. Input/output module 238 provides camera 240, microphone 242 and speaker 244 functionality, each in a well-known fashion. APP 234 may also, upon execution, begin collecting and storing data transmitted from the wearable personal safety device 102 and/or video transmitted from the personal flotation device 104 that may be accessed by emergency personnel in the event of a drowning or other personal emergency is detected. As will be appreciated, while the communications device 106 is configured as a smartphone any number of mobile devices that execute mobile applications may be utilized with the principles of the disclosed embodiments herein. As such, a “mobile device” in the context herein may comprise a wide variety of devices such as smartphones, laptop computers, tablets, and wearable device, to name just a few.

[0062] Turning our attention to FIGS. 3-6, FIG. 3 presents a perspective view of the underside of the wearable personal safety device 102 of FIG. 2 in accordance with an embodiment, and FIGS. 4 and 5 present an illustrative configuration for utilizing the latching mechanism of the wearable personal safety device 102 to communicatively couple with the communications device 106 and the personal flotation device 104 in accordance with an embodiment. More particularly, as shown in FIG. 3, the first band section 114-1 and the second band section 114-2 are configured for securing and coupling the wearable personal safety monitoring device 102 on the wearer's body (e.g., their wrist). The first band section 114-1 having the safety locking latch 116 positioned at a first position thereon to further facilitate securing the wearable personal safety monitoring device 102 by locking the first band section 114-1 to the second band section 114-2 by inserting the safety locking latch 116 into slot 300 located within the body of the second band section 114-2 at a first position therein in a conventional manner and activating the safety features thereof. As will be appreciated, the latch 116 may be childproofed to prevent a child from unlatching the wearable personal safety monitoring device.

[0063] As further detailed in FIG. 4, the wearer of the wearable personal safety monitoring device 102, starting in fully open position 400 of the band 114, will insert the safety lock latch 116 on the first band section 114-1 along direction 402 into the slot 300 of the second band section 114-2 to secure and couple the first band section 114-1 to the second band section 114-2. Once fully secured and coupled in a fully locked position 500 as shown in FIGS. 5 and 6, the safety features of the wearable personal safety monitoring device 102 are activated such as communicatively coupling the wearable personal safety monitoring device 102 with the communications device 106 by and through wireless communications links 108. FIG. 6 presents a cross-sectional view 600 of the latching mechanism of the wearable personal safety device 102 of FIG. 5 in the locked position 500 in accordance with an embodiment. As shown, the safety

lock latch 116 is fully inserted into the slot 300 of the second band section 114-2 thereby activating the safety features of the physiological and location sensor module 202, for example. In accordance with an embodiment, the wearable personal safety monitoring device 102 and/or the communications device 106 may be further communicatively coupled with a cloud-based platform (e.g., the Internet) to further provide the safety features herein in a networked fashion.

[0064] For example, in accordance with an embodiment, a proactive guidance system may be provided from a cloud service that provides the wearer of the wearable personal safety monitoring device 102 with instructions on how to use the device and the personal safety system 100 including but not limited to providing CPR instructions in the event of a drowning emergency to individuals who may be proximate the wearer at the time of the emergency. The network connections employed in the embodiments herein may be any type or form of network and may include, without limitation, a point-to-point network, a broadcast network, a wide area network, a local area network, a telecommunications network, a data communications network, a computer network, an asynchronous transfer mode (ATM) network, a synchronous optical network (SONET), a wire-line network and/or wireless network.

[0065] Cloud, cloud service, cloud server and cloud database are broad terms and are to be given their ordinary and customary meaning to one of ordinary skill in the art and includes, without limitation, any content database, data repository or storage media which store content typically associated with and managed by users, lifeguards, safety services (e.g., EMS), third party content providers, social media services, to name just a few. A cloud service may include one or more cloud servers and cloud databases that provides for the delivery of various personal safety applications as hosted by a third party service provider or operator. A cloud server may include an HTTP/HPTTTPS server sending and receiving messages in order to provide web-browsing interfaces to client web browsers (e.g., as executed on the communications device 106) as well as web services to send data to integrate with other interfaces (e.g., as executed on the communications device 106). The cloud server may be implemented in one or more well-known servers and may send and receive content in a various forms and formats, user supplied and/or created information/content and profile/configuration data that may be transferred to, read from or stored in a cloud database.

[0066] A cloud database may include one or more physical servers, databases or storage devices as dictated by the cloud service's storage requirements. The cloud database may further include one or more well-known databases (e.g., an SQL database) or a fixed content storage system to store content, profile information, configuration information or administration information as necessary to execute the cloud service. In various embodiments, one or more networks providing computing infrastructure on behalf of one or more users may be referred to as a cloud, and resources may include, without limitation, data center resources, applications (e.g., software-as-a-service or platform-as-a-service) and management tools. In this way, in accordance with various embodiments, the users may establish a variety of communications and/or operations to facilitate drowning prevention or other cases of accidents due to asphyxiation or heart rate conditions in a fully transparent fashion without

any required understanding of the underlying hardware and software necessary to interface, communicate, manipulate and exchange communications and data relevant for personal safety operations.

[0067] FIG. 7 presents a flowchart of illustrative operations 700 for facilitating drowning prevention or other cases of personal safety accidents due to asphyxiation or heart rate conditions, for example, using the personal safety system of FIG. 1 in accordance with an embodiment. In accordance with the operations 700 of FIG. 7 that begin at step 702, a user profile is created by the user of the wearable personal safety device 102 for defining specific user parameters including but not limited to name, weight, height, and emergency contacts and, at step 704, there is a setting of personal safety threshold levels for triggering alarms in event such thresholds are violated (e.g., exceeded or otherwise not met or complied with, as the case may be). Illustratively, the user may employ the communications device 106 through the execution of the APP 234 to complete such user profile and safety threshold level setting. At step 706, the user puts on (i.e., coupling) the wearable personal safety device 102 and the personal flotation device 104 as detailed herein above prior to entering the water and going swimming such that the devices are activated for monitoring the wearer's safety. At step 708, monitoring of the wearer's personal safety conditions begins, as detailed herein above, and if one or more thresholds is violated (e.g., a level too low or too high or not equal to the designated threshold value), as determined at step 710, then one or more alarms are triggered, at step 712, and one or more safety device activation signals are transmitted and features enabled. If no threshold violations are determined at step 710 monitoring continues until the activity ceases.

[0068] However, if one or more thresholds are violated and detected at step 710 then this is an indication that the wearer may be experiencing a drowning emergency. As such, as noted above, alarms are triggered on the wearable personal safety device 102 and the personal flotation device 104 and signals sent to the communications device 106 to further trigger audio and/or video alarms thereon and/or contacting emergency services by dialing "911" in a well-known fashion. Illustratively, upon detection of the threshold violation(s), the wearable personal safety monitoring device 102 transmits a first alert signal to the personal flotation device 104 to automatically inflate thereby raising the level of the swimmer in the body of water in which the swimmer is located and transmits a second alert signal to the communications device 106 such that this device registers a visual and/or auditory alarm thereon. The wearer will also be alerted, at step 714, to manually activate, at step 716, at least the personal flotation device (e.g., in the event signal transmission fails between the wearable personal safety device 102 and the personal flotation device 104. Upon activation (either manually or automatically), at step 716, of the personal flotation device 104, the rescue operation are performed, at step 718, that include but are not limited to the activation of the inflation module 222 thereby inflating the personal flotation device 104 and adjusting the wearer's body and/or head position in the body of water to mitigate the drowning conditions. In this way, the personal flotation device 104 causes a positioning of the body in the body of water to a second position in the body of water such that the previously detected personal safety condition that triggered the alert(s) no longer violates the predefined threshold. The

wearer may also manually activate the panic button 118 on the wearable personal safety device 102. Additional rescue operations may be performed including, but not limited to, transmitting the wearer's GPS location, illuminating the LEDs 112 on the wearable personal safety device 102 and/or the LEDs 124 on the personal flotation device 104, initiating execution of a cardiopulmonary (CPR) program, and initiating execution of tracking system to locate the wearer.

[0069] Thus, in accordance with the embodiments detailed herein above, the user is provided an end-to-end personal safety system to facilitate drowning prevention or other cases of accidents due to personal safety conditions such as asphyxiation or heart rate conditions. Turning our attention to FIGS. 8 and 9, FIG. 8 presents an illustrative scenario 800 of a person 802 utilizing the personal safety system of FIG. 1 in accordance with an embodiment under normal conditions (i.e., no emergency or other distress), and FIG. 9 presents an illustrative scenario 900 of a person utilizing the personal safety system of FIG. 1 in accordance with an embodiment under emergency conditions. As shown in FIG. 8, the person 802 has previously coupled the wearable personal safety device 102 and the personal flotation device 104 to their body and entered body of water 804 for a swim. In the illustrative scenario 800, the person 802 is swimming safely, a first position in the body of water 804, in that their head 810 and torso 812 remain above water level 808 of the body of water 804. In this way, at this first position the person 802 is not under any duress or nor suffering any type of drowning conditions as indicated by the NORMAL indicator 806 on the communications device 106 as registered by the communication device 106 from receiving a signal over the wireless communications links 108, as detailed herein above.

[0070] Alternatively, as shown in FIG. 9, the illustrative scenario 900 shows the person 802 wearing the wearable personal safety device 102 and the personal flotation device 104 and continuing their swim in the body of water 804. However, the person 802 (i.e., a body) is no longer swimming safely in that their head 810 and torso 812 are now submerged, at a second position in the body of water 804, below the water level 808 of the body of water 804. At this second position, the person 802 is now under duress and suffering from drowning conditions and gasping for air and/or dangerous heart rates. As a consequence, in accordance with the embodiment, there is now an ALERT indicator 904 on the communications device 106 as registered by the communication device 106 from receiving an alert signal over wireless communications links 108 indicating that the wearable personal safety device 102 has detected the drowning conditions and initiated emergency operations. As noted above, alarms are triggered on the wearable personal safety device 102 and the personal flotation device 104 and signals sent to the communications device 106 to further trigger audio and/or video alarms thereon and contacting emergency services by dialing "911" in a well-known fashion. Illustratively, upon detection of the threshold violation(s), the wearable personal safety monitoring device 102 transmits a first alert signal to the personal flotation device 104 to automatically inflate thereby raising the level of the swimmer in the body of water to now a third position in which the swimmer is located and transmits a second alert signal to the communications device 106 such that this device registers a visual and/or auditory alarm thereon. The wearer will also be alerted, to manually activate at least the

personal flotation device **104** (e.g., in the event signal transmission fails between the wearable personal safety device **102** and the personal flotation device **104**).

[0071] Upon activation, the personal flotation device **104** through the activation of the inflation module **222** will inflate (see, inflation state **902** as shown in FIG. **9**) the personal safety device **104** thereby adjusting the wearer's body and/or head to the third position in the body of water to mitigate the drowning conditions and returning to safe conditions. The wearer may also manually activate the panic button **118** on the wearable personal safety device **102**. As such, the personal flotation device **104** causes a positioning of the person **802** (i.e., a body) in the body of water **804** to the second position in the body water **804** such that the previously detected personal safety condition that triggered the alert(s) no longer violates the predefined threshold. Additional rescue operations may be performed including, but not limited to, transmitting the wearer's GPS location, illuminating the LEDs **112** on the wearable personal safety device **102** and/or the LEDs **124** on the personal flotation device **104**, initiating execution of a cardiopulmonary (CPR) program, and initiating execution of tracking system to locate the wearer.

[0072] Further, it will be noted that the body of water **804** may be any type or body of water (e.g., freshwater, saltwater, chlorinated waters, bathtub water, etc.) and while the illustrative embodiment in FIG. **9** is directed to a water-based emergency (i.e., drowning) the principles of the embodiments described herein apply equally to a land-based emergency or any emergency under which a person is suffering from an event involving at least physiologic indicator that manifest in low oxygen levels, asphyxiation or deleterious heart rate conditions. For example, the wearable personal safety device **102** may be used in military training during land-based exercises or any activity where pre-existing medical conditions such as asthma, sleep apnea, irregular heart rate or epilepsy, to name just a few.

[0073] In some embodiments the method or methods described above may be executed or carried out by a computing system including a tangible computer-readable storage medium, also described herein as a storage machine, that holds machine-readable instructions executable by a logic machine (i.e. a processor or programmable control device) to provide, implement, perform, and/or enact the above described methods, processes and/or tasks. When such methods and processes are implemented, the state of the storage machine may be changed to hold different data. For example, the storage machine may include memory devices such as various hard disk drives, CD, or DVD devices. The logic machine may execute machine-readable instructions via one or more physical information and/or logic processing devices. For example, the logic machine may be configured to execute instructions to perform tasks for a computer program. The logic machine may include one or more processors to execute the machine-readable instructions. The computing system may include a display subsystem to display a graphical user interface (GUI) or any visual element of the methods or processes described above. For example, the display subsystem, storage machine, and logic machine may be integrated such that the above method may be executed while visual elements of the disclosed system and/or method are displayed on a display screen for user consumption. The computing system may include an input subsystem that receives user input. The input subsystem may

be configured to connect to and receive input from devices such as a mouse, keyboard or gaming controller. For example, a user input may indicate a request that certain task is to be executed by the computing system, such as requesting the computing system to display any of the above-described information, or requesting that the user input updates or modifies existing stored information for processing. A communication subsystem may allow the methods described above to be executed or provided over a computer network. For example, the communication subsystem may be configured to enable the computing system to communicate with a plurality of personal computing devices. The communication subsystem may include wired and/or wireless communication devices to facilitate networked communication. The described methods or processes may be executed, provided, or implemented for a user or one or more computing devices via a computer-program product such as via an application programming interface (API).

[0074] FIG. **10** shows an alternative embodiment of a personal aquatic safety device **1000** where the flotation components and monitoring components have been integrated into an inflatable vest **1002**. The vest **1002** includes two or more inflatable pockets **1003** and at least one vital sign monitor. In this embodiment, two types of vital sign monitors are used: a heart rate monitor **1004**, a respiration rate monitor **1005**, and a pulse oximeter **1006** which are held securely against the wearer's body by an elastic band **1008** on the inside of the inflatable vest **1002**. In this embodiment, the heart rate monitor **1004** is positioned in the center of the chest and the pulse oximeter **1006** is positioned on one sides of the chest. The respiration rate monitor **1005** uses changes in the tension of the elastic band **1008** to measure the rate and extent of respiration. The elastic band **1008** is loose enough to be comfortable for the wearer but tight enough to firmly hold the vital sign monitors against the wearer's skin to allow accurate readings. Optionally, additional monitors may be added, and the elastic band **1008** may optionally be adjustable. Those skilled in the art will appreciate that the chest is not an ideal location for an oximeter. Therefore, when an oximeter is used as a physiological monitor, it may be preferable to use a safety system that includes a wrist band on which an oximeter may be placed.

[0075] In this embodiment, several components are located within a housing **1012** to protect the components and their electrical connections from exposure to water or other deleterious materials. The housing **1012** houses a speaker **1014** four emitting an audio alarm, a microcontroller **1016**, a wireless transmitter **1018** an indicator light **1020**, a power button **1022**, a panic button **1024**, a GPS module **1028**, and a haptic alarm **1030**. The wireless transmitter **1018** allows the safety device **1000** to be communicatively linked to a Wi-Fi network and/or a particular electronic device such as a smart phone **1032**. Optionally, the safety device **1000** may be linked to a tablet, laptop or other computer device or computer network. As explained above, a smart phone app or other software may then be used to program the microcontroller **1016** with predetermined values for the parameters measured by the vital sign monitors, including minimum or maximum values which will trigger the alarms and/or the flotation device.

[0076] The personal aquatic safety device **1000** also includes a water contact sensor **1010** for determining whether the device **1000** is submerged, a depth gauge **1011**, and two visual alarms **1034** on each shoulder of the inflat-

able vest **1002**. In this embodiment, the visual alarms **1034** comprise bright lights that may be set to flash one or more colors when activated. The inflatable vest **1002** also includes a blow tube **1036** for manually inflating the pockets **1003**. The inflatable vest **1002** also includes a pressurized gas source **1036**, which in this embodiment is a carbon dioxide cartridge. Those skilled in the art will appreciate that there are a variety of devices that may be used to provide gas for rapid inflation of pockets in an inflatable device, and that many of these will be suitable for the present invention. The pressurized gas source **1037** may be actuated manually by pulling the cord **1038** or may be actuated automatically by the microcontroller **1016**.

[0077] In use, the personal aquatic safety device **1000** and is turned on by depressing the power button **1022**. When the microcontroller **1016** detects that there is sufficient power from the power supply source, that the vital sign monitors and other components of the device **1000** are functioning properly, and it is able to establish a wireless connection with the smart phone **1032** or other device, the indicator light **1020** will emit a constant green light. If one or more components are not functioning properly, there is insufficient power or it cannot establish a connection, the indicator lights **1020** may emit red, yellow or other colored light and may blink. An operator then uses the smart phone **1032** or other device to set minimum, maximum, or ranges of values for the various parameters measured by the vital sign monitors. The personal aquatic safety device **1000** then proceeds to monitor the wearer's vital sign parameters measured by the vital sign sensors, either continuously or at intervals. When the microcontroller **1016** detects that one or more vital sign parameters is outside an acceptable range, it will actuate the haptic alarm **1030**. During vigorous activity, the vest **1002** or the various vital sign sensors may be jostled, moved out of place or temporarily removed from communication with the wearer. These events may cause false readings. Therefore, the haptic alarm **1030** is actuated first. If the wearer is not in distress, he or she may depress the power button **1022** to reset the device **1000** to continue monitoring his or her vital signs. If the wearer does not reset the device **1000** within a predetermined amount of time, such as for example 10 or 15 seconds, the microcontroller **1016** will proceed to actuate the audio alarm through the speaker **1014** and the visual alarms **1034**. If the water contact sensor **1010** and/or the depth gauge **1022** detect that the inflation vest **1002** is currently submerged, the microcontroller **1016** will actuate the pressurized gas source **1036** to inflate the inflatable pockets **1003**, thereby raising the wearer of the aquatic safety device **1000** to the surface. Once the device **1000** is at the surface, the microcontroller **1016** can reestablish wireless communication with the smart phone **1032** or other electronic device using its wireless transmitter **1018** and send an alert to the smart phone **1032** or other device. As a result, within an extremely short period of time, the device can detect that the wearer is in distress, rapidly send the wearer to the surface of the water, generate both audio and visual alarms within the proximity of the wearer, and also send an alarm to a remote location via a wireless network. The wearer is thus removed from immediate danger of drowning and alarms sufficient to notify others of the wearer's distress are rapidly initiated. The wearer experiences distress, he or she may depress the panic button **1024**, which will immediately trigger the alarms and the pressurized gas source **1036**. Optionally, the panic button

1024 is only activated after it has been depressed continuously for a predetermined length of time, for example three seconds or five seconds.

[0078] The depth gauge **1011** and the GPS module **1022** are optional. However, when they are included the microcontroller **1016** may record the time a wearer spends at which depths and provide that information, along with a GPS location, as part of the alert signal it wirelessly transmits to a smart phone or other device. The microcontroller can also document the rates of ascent and descent of the wearer. This information can be included in the distress signal sent by the transmitter, allowing people responding to the distress signal to better prepare whatever aid is required to the wearer of the safety device.

[0079] FIGS. 11-13 show another alternative embodiment of a personal aquatic safety device **1100** in accordance with the principles of the invention. In this embodiment, a housing **1102** attaches to a wearer's wrist using band **1104** that has a safety lock **1106**. Optionally, the housing **1102** may be incorporated into any type of garments, such as a shirt, pants, socks, hat or any other suitable device so long as it may be positioned and secured in a manner that allows the vital sign monitor **1108** to accurately measure the wearer's vital signs. In this embodiment, the band **1104** and safety lock **1106** operate in the same manner as described in the first embodiment above. A vital sign monitor **1108** is located on the bottom of the housing **1102** such that it is in contact with the wearer's wrist. The housing **1102** includes an internal microcontroller (as described above), not shown, a water sensor and/or a depth gauge **1113**, and also includes a detachable, deployable tracker **1110**. The deployable tracker **1110** houses the wireless transmitter **1112**, a speaker **1114** and a light **1116**. The deployable tracker **1110** is also buoyant and will float to the surface if it is released from the housing **1102** while underwater. The housing **1102** also includes a panic button **1118**, and indicator light **1120** and a power button **1122**. The safety device **1100** may be programmed using a remote computer or electronic device in wireless communication with the transmitter **1112** to set parameters for defining when the wearer is in distress.

[0080] When the safety device **1100** detects vital signs indicating that the wearer is in distress, the speaker **1114** will emit an audible alarm, the light **1116** will emit a visual alarm, for example bright flashing red light, and the transmitter **1112** will wirelessly transmits a distress signal, as explained above. If the water sensor/depth gauge **1113** detects that the safety device **1100** is submerged, the safety device **1100** will automatically release the deployable tracker **1110**. Because the deployable tracker **1110** is buoyant, it will rise to the surface of the water so that the audio and visual alerts can be more easily seen or heard, and so that the transmitter **1112** is able to send the wireless distress signal. The personal aquatic safety device **1100** may also optionally include a GPS module so that the location of the wearer in distress may be provided in the distress signal.

[0081] FIG. 13 shows a flotation garment **1150**. In this embodiment, the flotation garment is a shirt. The flotation garment **1150** may be used in conjunction with the personal aquatic safety device **1100** shown in FIGS. 11 and 12. To combine the safety device **1100** with the shirt **1150**, a wearer inserts the plugs **1152** extending from the sleeve **1154** of the shirt **1150** into the sockets **1156** of the safety device **1100**. The plugs **1152** provide electrical communication between the safety device **1100** and inflation device **1158**. When the

safety device **1100** determines that the wearer is in distress and is in the water, the device **1100** actuate the inflation device **1158** and the shoulder lights **1159** to provide a visual alarm. The inflation device **1158** releases a pressurized gas source **1160** that fills the flotation pockets **1162** with pressurized gas. The pressurized gas may be carbon dioxide or other gases from a cartridge, or may utilize other suitable means for inflating a flotation device. The flotation device **1150** may also optionally include a manual trigger **1164**, such as for example a rip cord as explained above, for actuating the pressurized gas source **1160**, and may also include a blow to for manually inflating the inflatable flotation pockets **1162**. The flotation device **1150** is suitable for any type of water. The flotation garment **1150** may optionally have a different configuration, but preferably is designed such that the head of the wearer will be above water when the garment is inflated. Therefore, the garment should generally have inflatable pockets around the upper chest. A garment consisting only of pants would generally not be desirable. The flotation garment **1150** is washable and may be configured to be aesthetically pleasing. It may be desirable to make the flotation garment highly visible, being composed of bright, reflective or glow in the dark materials.

[0082] When the safety device **1100** is used with the flotation device **1150**, it may be set to activate the inflation device **1158** if vital signs being monitored fall outside an acceptable range, for example if blood oxygen is being monitored, the device **1100** may be set to inflate the vest if saturation falls below 94%. The safety lock and the flotation garment may be configured to only be removable when actuated remotely using a wirelessly connected electronic device. The safety device may be programmed to automatically inflate the flotation garment if a water sensor detects water, thus inflating automatically upon entering water. This may be a preferable setting for young children.

[0083] The embodiment shown in FIGS. **11** and **12** provide a relatively small, unobtrusive personal aquatic safety device **1100** that may be worn at all times, not just when the wearer is in the proximity of water. This may be advantageous, for example when a parent has one or more young children in the vicinity of the lake, neighborhood pools or other bodies of water that a child is not necessarily intended to be near or get in unsupervised. A parent would thus be alerted if a young child happens to accidentally fall into a neighbor's pool when no one is looking. The device is also suitable for use with a small child at a playground, at a park, while camping or in other locations where they might not be under direct, proximal supervision of one or more adults at all times. The personal aquatic safety device **1100** may optionally include only a haptic alarm that is activated by the microcontroller when the sensor(s) detect one or more physiological indicators is outside acceptable preselected parameters. The haptic alarm may be turned off by depressing the power button. If the haptic alarm is not turned off by the wearer after a predetermined amount of time, for example 10, 15 or 30 seconds, then the microcontroller will activate the transmitter to begin sending a distress signal. The distress signal may not be received clearly if the safety system is underwater. Therefore, the microcontroller will also detach the deployable tracker which has positive buoyancy and will float to the surface. From the surface of the water the distress signal will be more readily received. The microcontroller will also activate any audio and/or visual alarms on the deployable tracker which will also be heard for

seen by persons in the vicinity once the deployable tracker reaches the surface. The GPS module may also be located in the deployable tracker so that it can provide location data to be included in the distress signal.

[0084] The personal aquatic safety device **1100** will function in much the same way on dry land, except that if the device does not detect that it is in water (using the water sensor and/or depth gauge) it will not detach the deployable tracker, but will otherwise carry out the same functions.

[0085] Thus the safety device **1100** shown in FIGS. **11** and **12** works on land and water (any body of water i.e. fresh, salt, chlorine, bathtubs, etc.). The personal aquatic safety device **1100** is preferably located on the wrist, but can also be attached to other parts of the body, such as for example a foot, ankle, fingers, toes, hand/palm, forehead, chest, elbow, knees, and/or neck. Any region of the body where the vital sign monitor(s) are able to take accurate readings will be suitable. The vital sign monitor need not be directly attached to the housing, but need only be in communication with the other components of the safety system. For example, physiological monitors as described below which are part of the band are easily used with the safety system **1100** as well as the other embodiments in the figures. The safety device may optionally include other features. For example, it may include a compass that may be read by the wearer. It may also include a camera, video monitor and microphone, allowing it to act as a means for providing audio and visual communication in real time through the transmitter.

[0086] The safety lock is preferably only releasable via a remote electronic device, such as for example an application on a smartphone. A smartphone application may also be used to set the preselected acceptable and unacceptable parameters for the various vital signs being read. The safety system **1100** may be configured using any wirelessly connected electronic device, which may be used to set various physiological parameters, adjust the volume, brightness, duration and/or patterns of the alarms, and turn on and off various features of the safety system. The software application used to wirelessly communicate with the safety system may also be used to release the safety lock, activate or deactivate various features of the device, store data received from the device via a distress call or any other transmission. The application may also receive signals sent by the safety system's transmitter what confirm that the various components of the system are connected and functioning.

[0087] FIGS. **14-16** show another alternative embodiment of a personal aquatic safety device **1200** in accordance with the principles of the invention. The safety device **1200** is similar to the safety device **1100**, but may be more suitable for use with adults in the open ocean, particularly when they are free diving or scuba diving. The personal aquatic safety device **1200** is also designed to fit about the wearer's wrist or forearm, to which it is secured by an elastic, possibly adjustable, band **1202**. In this embodiment, the two vital sign monitors **1204** and **1206** are located on the band **1202** away from the housing **1208**. This allows the wearer to position the safety device **1200** such that the vital sign monitors **1204** and **1206** lie against the inside of his or her wrist or forearm while the housing **1208** is positioned on the outside of the arm so that it may be viewed like a watch. The housing **1208** includes a depth gauge **1210**, an indicator light **1212**, a panic button **1214**, a haptic device **1216**, a microcontroller **1218**, a display panel **1220**, and a power button **1222**. The safety

device **1200** also includes a detachable deployable tracker **1224**. The deployable tracker **1224** includes a wireless transmitter **1226**, a GPS module **1227**, a speaker **1228**, an inflatable buoy **1230**, and a pressurized gas source **1232**. As with other embodiments described above, the wireless transmitter **1226** allows the safety device **1200** to be programmed with parameters for the monitored vital signs to detect when a wearer is in distress. The display panel **1220** displays current readings from the monitors in real time. The indicator light **1212** lights up to indicate that the device is functioning properly and may change color and/or blink if one or more components are not functioning properly, or if there is insufficient power. When the measured vital signs monitored by vital sign monitors **1204** and **1206** fall outside the acceptable parameters, the microcontroller **1218** activates the haptic device **1216** to vibrate to alert the wearer of possible distress. The indicator light **1212** may also flash to indicate that distress has been detected. The microcontroller **1218** will allow a predetermined amount of time, for example 10 or 15 seconds, to relapse prior to taking further action. If the wearer is not in distress, he or she may actuate the power button **1222** to reset the device so that it continues to monitor his or her vital signs. If the wearer does not reset the device, or if the wearer depresses the panic button for a predetermined amount of time, for example three seconds or five seconds, the microcontroller **1218** will release the detachable deployable tracker **1224**. The safety device **1200** and the deployed tracker **1224** remain connected by a wire **1236** that is coiled and stored within the safety device **1200**. Once detached, the deployable tracker **1224** will automatically actuate the pressurized gas source **1232** to inflate the buoy **1230**, and to begin emitting an audio alert through the speaker **1228** and two also emit a wireless distress signal through the transmitter **1226**. In this embodiment, the inflatable buoy **1230** includes an LED light strip **1238** and an antenna **1240**, both of which extend along the length of the buoy **1230**. The buoy may also be of a bright color such as boring to read to attract attention. When the deployed tracker **1224** reaches the surface of the water, the buoy **1230** extends at least partially into the air to improve visibility of visual alert generated by flashing the LED light strip **1238**. The antenna **1240** extending the length of the buoy **1230** also improves transmission of the wireless distress signal.

[0088] Those skilled in the art will appreciate that scuba divers and free divers often dive to relatively deep depths. Were the scuba diver to wear a vest that inflates and immediately sends the diver to the surface, the scuba diver could suffer from decompression sickness, also known as “the bends,” which can be fatal. Scuba divers also rarely utilize equipment that allows verbal communication between each other. Thus, when a scuba diver is in distress, other divers in his or her vicinity may not recognize that the diver is experiencing distress. Even if other divers do realize something is wrong, it is often difficult or impossible to discern what type of distress a diverse suffering from. Wireless transmitters generally do not carry a signal a substantial distance through water. Similarly, GPS modules do not work well underwater unless specially modified. The deployable tracker **1224** of the present invention allows both the transmitter **1226** and the GPS module **1227** to reach the surface quickly so that a distress signal may be relayed to the dive boat or other persons in the vicinity. The distress signal can include the trackers precise location as well as the vital signs and depth of the diver in distress. This allows respond-

ers from the dive boat or elsewhere to quickly locate the diver in distress and have some preliminary information on the nature of the distress the divers experiencing. By providing the haptic warning prior to deploying the tracker **1224**, the safety device **1200** prevents the tracker **1224** from deploying accidentally. Connection of the safety device **1222** the tracker **1224** with the cord **1236** is optional. The tracker **1224** may be deployed without any connection to the safety device **1200**. Removing the cord **1236** from the safety device **1200** avoids the need to store a potentially very long cord within the device. However, it may be more difficult to locate a distressed diver without the cord **1236**. In addition, the cord **1236** may be used to constantly update the distress signal emitted by the transmitter **1226** to inform anyone receiving the distress signal of the divers current depth and vital sign readings.

[0089] FIGS. 17 and 18 show another alternative embodiment of a personal aquatic safety device **1300** in accordance with principles of the invention. The safety device **1300** is similar to the safety device **1200** shown in FIGS. 14-16. In this embodiment however, the personal aquatic safety device is incorporated into a dive suit **1302**. The dive suit **1302** includes one or more vital sign monitors **1304** secured in place by an elastic band **1306**. A wearer may also optionally attached the vital sign monitors **1304** using an adhesive or other methods to ensure accurate readings by the monitors. The safety device **1300** also includes a housing **1308** which either attaches to the wearer's wrist or is integrated into the wrist region of the wetsuit **1302**. The housing **1306** includes a microcontroller, haptic device, power button, indicator light and panic button as shown in the previous embodiments. The housing **1308** also includes a display screen **1309** and may include one or more buttons for programming the safety device **1300**. The safety device **1300** also includes a deployable tracker **1310** substantially similar to the deployable tracker **1224** shown above. Specifically, it includes a wireless transmitter, a pressurized gas source and an inflatable buoy **1312**. The tracker **1310** preferably also includes a GPS module. The inflatable buoy **1312** is an elongate buoy commonly used by scuba divers as a “sausage” because of the elongate shape. SCUBA divers commonly carry sausages during a dive and deploy them to assist a dive boat picking them up at the end of a dive. Thus, the inclusion of the deployable tracker **1310** does not require substantial additional equipment. A typical sausage may also be easily incorporated into the tracker **1310** as the buoy **1312**. The deployable tracker **1310** may also include an LED light strip and/or an antenna fitted along the length of the sausage. The deployable tracker **1310** may be attached to the dive suit **1302** by a cord **1314** attached to an anchor **1316** when the tracker **1310** is deployed. Optionally, the tracker **1310** may be deployed without use of a cord **1314** attached to the dive suit **1302**.

[0090] FIG. 18 presents a flowchart **1400** representing basic programming for a personal aquatic safety device in accordance with the principles of the invention. In step **1402**, the personal aquatic safety device is program by entering the acceptable parameters for any vital signs monitored by the safety device. In step **1404**, the safety devices been attached to the wearer. Steps **1402** and **1404** may be reversed or may be performs substantially simultaneously. Once the safety device is properly programmed and properly affixed to the wearer, it begins monitoring the wearer's vital signs as shown in step **1406**. This monitoring may be done

periodically or continuously. So long as the monitor vital signs remain within acceptable parameters, the device simply continues to monitor the wearer's vital signs, step **1409**, unless the panic button is activated as shown in step **1408**. If a wearer activates the panic button, the safety device uses a haptic device to alert the wearer that the panic button has been activated as shown in step **1410**. Similarly, if the safety device detects that final signs are no longer within acceptable parameters, it will initiate the haptic device to alert the wearer, step **1410**. If the wearer deactivates the alarm within a predetermined time period, step **1412**, the safety device will simply return to monitoring the wearer's vital signs. However, if the wearer does not deactivate the safety device, it will proceed to steps **1414** and **1416**, generating a distress signal and actuating a flotation device. In this flowchart, step **1416**, send distress signal, represents generating an audio alarm, a visual alarm, and/or sending a wireless distress signal. Step **1414** of this flowchart refers to either inflating pockets of a flotation vest, shirt or other garment, or to the release of a deployable tracker which then floats upward to the surface of the water.

[0091] Whereas, the present invention has been described in relation to the drawings attached hereto, other and further modifications, apart from those shown or suggested herein, may be made within the spirit and scope of this invention. Those skilled in the art will appreciate that the conception, upon which this disclosure is based, may readily be utilized as a basis for the designing of other structures, methods and systems for carrying out the several purposes of the present invention. That is, the invention is not limited in its application to the details of construction and to the arrangements of the components set forth in the following description or illustrated in the drawings. The invention is capable of other embodiments and of being practiced and carried out in various ways. Also, it is to be understood that the phraseology and terminology employed herein are for the purpose of description and should not be regarded as limiting. The descriptions of the embodiments shown in the drawings should not be construed as limiting or defining the ordinary and plain meanings of the terms of the claims unless such is explicitly indicated. The claims should be regarded as including such equivalent constructions insofar as they do not depart from the spirit and scope of the present invention.

1. A personal aquatic safety device comprising:

at least one monitor selected from the group of a heart rate monitor, a blood pressure monitor, a blood oxygen saturation monitor, a heart rate monitor, a pulse oximeter, a carbon dioxide level monitor, and a respiration rate monitor;
 a programmable microcontroller;
 at least one alarm device selected from the group of an audio alarm, a visual alarm and a haptic alarm;
 an alarm deactivation button that, when activated, turns off the at least one alarm;
 an inflatable flotation device; and,
 a wireless transmitter;
 wherein the microcontroller actuates the at least one alarm device when the at least one monitor detects a predetermined value; and,
 wherein the microcontroller actuates the flotation device and actuates the transmitter to send a distress signal

transmitter when the at least one alarm device remains actuated for a predetermined amount of time.

2. The personal aquatic safety device of claim **1** further comprising a panic button that, when activated, actuates the flotation device and actuates the transmitter to send a distress signal transmitter.

3. The personal aquatic safety device of claim **2** further comprising a GPS module.

4. The personal aquatic safety device of claim **3** wherein the flotation device is an inflatable vest.

5. The personal aquatic safety device of claim **4** wherein the flotation device is inflated using a CO2 canister.

6. The personal aquatic safety device of claim **5** wherein the flotation device includes a manual blow tube and a manual release rip cord.

7. The personal aquatic safety device of claim **6** further comprising a depth gauge.

8. The personal aquatic safety device of claim **7** further comprising a sensor that detects when the aquatic personal safety device is submerged.

9. The personal aquatic safety device of claim **8** wherein the flotation device and wireless distress signal transmitter are housed within a deployable tracker, wherein the deployable tracker, upon receiving a signal from the microcontroller, detaches from the aquatic safety device, actuates the flotation system, and transmits a wireless distress signal.

10. The personal aquatic safety device of claim **9** wherein the deployable tracker is communicatively connected to the safety device via a cord.

11. The personal aquatic safety device of claim **10** wherein the safety device is integrated into a scuba diving suit.

12. The personal aquatic safety device of claim **10** further comprising an accelerometer and wherein the microcontroller records rates of ascent and descent of the device.

13. A personal aquatic safety device comprising:

at least one monitor selected from the group of a heart rate monitor, a blood pressure monitor, a blood oxygen saturation monitor, a heart rate monitor, a pulse oximeter, a carbon dioxide level monitor, and a respiration rate monitor;

a programmable microcontroller;

a first alarm selected from the group of an audio alarm, a visual alarm and a haptic alarm;

an alarm deactivation button that, when activated, turns off the alarm;

a detachable deployable tracker having positive buoyancy; and,

a wireless transmitter;

wherein the microcontroller activates the alarm when the at least one monitor detects a predetermined value; and,

wherein the microcontroller detaches the deployable tracker and actuates the transmitter to send a distress signal when the first alarm remains activated for a predetermined amount of time.

* * * * *