

(12) STANDARD PATENT
(19) AUSTRALIAN PATENT OFFICE

(11) Application No. **AU 2009222455 B2**

(54) Title
Life-saving apparatus

(51) International Patent Classification(s)
B63C 9/08 (2006.01)

(21) Application No: **2009222455**

(22) Date of Filing: **2009.09.25**

(43) Publication Date: **2009.10.22**

(43) Publication Journal Date: **2009.10.22**

(44) Accepted Journal Date: **2012.12.13**

(62) Divisional of:
PCT/IL2008/000223

(71) Applicant(s)
Sosmart Rescue Ltd.

(72) Inventor(s)
Lahyani, Iris

(74) Agent / Attorney
Griffith Hack, Level 10 161 Collins Street, Melbourne, VIC, 3000

(56) Related Art
WO2005/035356

Abstract

Life-saving apparatus comprises a controller mountable on a user, for analyzing data related to the user and for initiating a life saving operation after the user has been in an actual or impending distress for a predetermined time. An orientation sensor for sensing the angle of the longitudinal axis of the user with respect to a horizontal plane sends a signal to the controller to initiate the life saving operation when the angle is indicative of a predetermined angular deviation for a predetermined threshold time. In one embodiment, the apparatus comprises an inflatable swimming garment provided with an inflatable part for causing the user to float while being in distress such that his head is upwardly directed. In one embodiment, the controller is used to transmit a wireless signal if the user has passed outwardly from one or more boundaries of a predetermined range during a sport related activity.

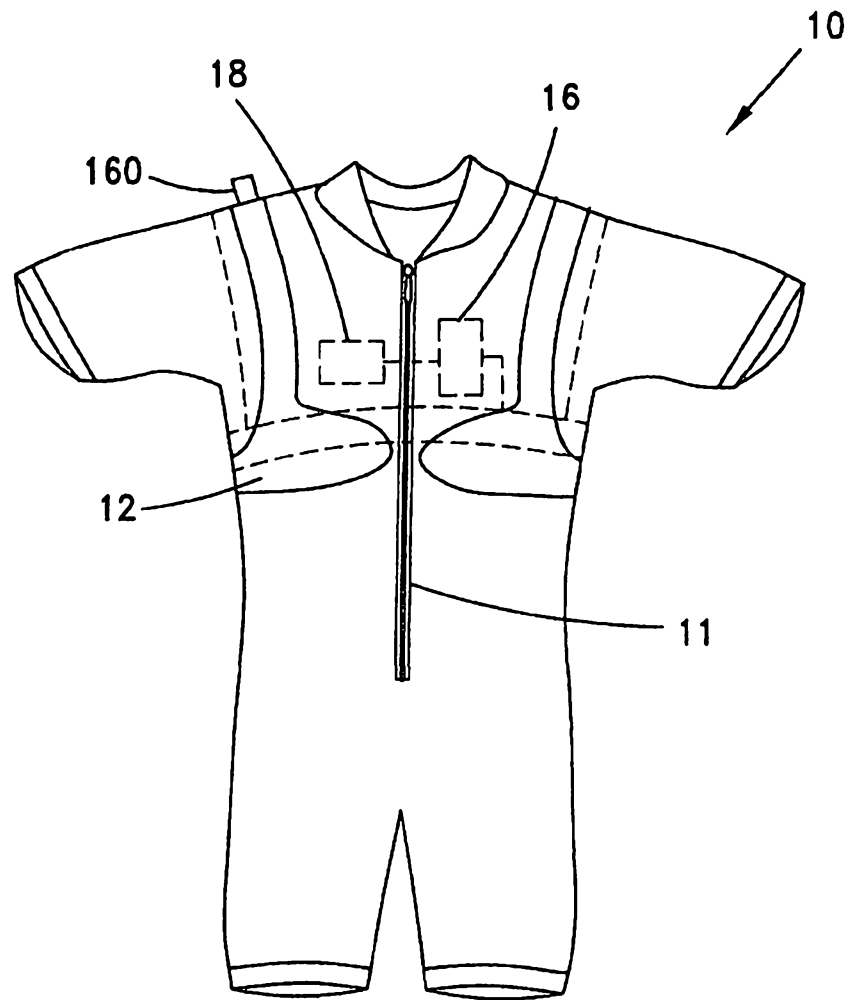


Fig. 1

2009222455 25 Sep 2009

AUSTRALIA

Patents Act 1990

COMPLETE SPECIFICATION

Standard Patent

Applicant(s):

SOSMART RESCUE LTD.

Invention Title:

Life-saving apparatus

The following statement is a full description of this invention,
including the best method for performing it known to me/us:

LIFE-SAVING APPARATUSDivisional Application

This application is a divisional application of the Australian designation of PCT/IL2008/000223

5 (WO 2008/102354) the disclosure of which is incorporated herein by reference.

Field of the Invention

The present invention relates to life saving apparatus. The invention also relates to an inflatable
10 life-saving swimming garment for children and toddlers, and which is operable automatically or manually in distress and emergency situations.

Background of the Invention

Life-saving swimming garments are designed to
15 decrease the number of drowning cases amongst children while swimming in the open sea or in swimming-pools. Swimming in the open sea requires overcoming safety problems, such as powerful drift currents and swirls, which are risky even for a skilled swimmer.

20 During the swimming season, swimming areas in the sea and swimming-pools are enormously crowded, and therefore, the ability of lifeguards to notice an emergency situation is limited, particularly in case of a drowning child who is not a skilled swimmer. It requires only a few seconds
25 for a small child to disappear underwater without any attention paid by the adults in the vicinity, and especially the attention of the lifeguard who has to notice any exceptional or emergency situation. Also, toddlers, who have been left unsupervised in a bath for
30 few moments, can lose their balance, while sitting, and drown, even though it is very shallow water.

Several approaches to overcome drowning problems use

buoyant clothing, e.g., inflatable arm bands, annular flotation members, etc. All these inflatable devices generally limit the mobility of a young swimmer so that he cannot enjoy the swimming activity. Therefore, inflatable devices are usually not worn by the children who have developed some swimming skills. Those swimming skills are often not sufficient to function in panic situations or at momentary lapsing of the swimmer's capabilities. Moreover, in most cases, toddlers or babies take off the inflatable device or refuse to put it on.

JP 2,241,890 discloses a floating device for rescuing a drowning person. The floating device is a necklace-shaped float tube that fits, before inflation, onto the neck of the swimmer. The necklace-shaped float tube is attached to a miniature sealed sack by means of an air pipe. The sealed sack contains miniature timer, an electronic circuit and an air bottle. The air bottle comprises a valve which is located in the air bottle stopper. The valve is connected to the electronic circuit which is attached to the miniature timer by wiring. A water-sensor that floats on the water surface is connected to the electronic circuit, by a wire. When the swimmer is drowning, the water-sensor wire is forced against the water-sensor which is sunk down and activates the miniature timer. The miniature timer is adjusted by the swimmer to a threshold underwater time. When the threshold time lapses, a signal is sent to the electrical circuit which, in turn, sends a command to the valve to open. After the valve is opened, the air from the bottle flows to the float tube through the air pipe, and inflates it. Thus, the inflated float tube floats to the swimmer up above the water surface level for breathing. However, there are some drawbacks associated with this device. When a child is playing in the sea or in a swimming-pool where the water is shallow, the danger of drowning still exists. In this case, the floating/rescuing device may be useless

when a child is lying unconscious at the bottom of shallow swimming-pool or sea. The floating device may not inflate because the water-sensor is not deep enough to create the appropriate force between the water-sensor and the sealed sack, which is needed to operate the miniature timer. On the other hand, a child who is a more skilled swimmer wants to dive more than a few centimeters below the water surface level without restrictive devices. Using the device described hereinabove, restricts the swimmer to stay close to the water surface level. Thus, false alarms may be caused.

An additional drawback of such devices is their arrangement/structure. Swimming or paddling within an aquatic environment should be safe and comfortable feeling. This floating device, when inflated, may apply pressure on the neck and may cause blood flow and breathing problems. Furthermore, the device's components are attached to the float tube by an air pipe and a wire that hang freely from the neck, thereby interrupting swimming.

WO 2007/038794 discloses freediving safety apparatus provided with a customized emergency flotation device that automatically inflates under a number of life threatening circumstances. This apparatus is not suitable for children and toddlers who are incapable of engaging in freediving. Also, this apparatus is incapable of providing indication whether a toddler has fallen backwardly or forwardly into the water.

It is therefore an object of the present invention to provide an inflatable life-saving swimming garment for children and toddlers which overcomes one or more of the problems associated with the prior art discussed above.

It is an advantage of the present invention to provide an inflatable life-saving swimming garment for

children and toddlers which is operable automatically in an actual emergency situation.

5 It is yet another advantage of the present invention to provide an inflatable life-saving swimming garment for children, which is instantly operable when the child is in distress.

10 It is an additional advantage of the present invention to provide an inflatable life-saving swimming garment for children and toddlers which floats them up with the head directed upward.

It is another advantage of the present invention to provide an inflatable life-saving swimming garment for children and toddlers that is reliable.

15 Additional objects and advantages of the present invention shall become clear as the description proceeds.

Summary of the Invention

20 The present invention is directed to life-saving apparatus. According to one embodiment, the apparatus comprises a controller mountable on a user, for analyzing data related to said user and for initiating a life saving operation after said user has been in an actual or impending distress for a predetermined time; and an orientation sensor for sensing the angle of the longitudinal axis of said user with respect to a horizontal plane and for sending a first signal to said controller to initiate said life saving operation when said angle is indicative of a predetermined angular deviation for a first predetermined threshold time.

30 In one aspect of this embodiment, the controller may be waterproof controller and may be mountable on a user disposed in an aquatic environment.

In another embodiment, the apparatus comprises:

5 a) an inflatable part (optionally with separated inflatable sections that are) attached to a garment worn by an upper body part of a user disposed in an aquatic environment, for causing said user to float while being in distress such that his head is upwardly directed, and for creating, when inflated, a volume difference between the upper body part and a lower body part; and

b) an inflating system, which comprises:

10 i. a gas tank with compressed gas for inflating, whenever required, said inflatable part;

15 ii. a controllable valve connecting between said gas tank and said inflatable part, for allowing, whenever required, said compressed gas to inflate said inflatable part;

20 iii. a waterproof electric or electronic controller for analyzing data related to said user and for opening said valve after said user has been in an actual or impending distress for a predetermined time;

25 iv. an orientation sensor for sensing an angle of the longitudinal axis of said user with respect to a horizontal plane and for sending a first signal to said controller to open said valve when said angle is indicative of a predetermined angular deviation for a first predetermined threshold time;

iv. a digital timer;

30 v. a processing unit for receiving data from said timer and for sending a second signal to said valve to open when a threshold time lapses;

vi. a depth-meter for measuring a current depth of said user and a depth-meter adjusting button

for adjusting a threshold depth, said timer counting
down to said first threshold time after the
predetermined angular deviation has been sensed or
down to a second threshold time when said user is
5 submerged deeper than or equal to said threshold
depth, whereby said processing unit sends said second
signal to said valve to open when said second
threshold time lapses and said user is submerged
deeper than or equal to said threshold depth or when
10 said first threshold time lapses and said angle of
the longitudinal axis of said user with respect to
the water surface is indicative of said predetermined
angular deviation; and

viii. a battery for supplying electrical power
15 for the operation of said inflating system.

The inflatable part may be attached to the swimming
garment by gluing or sewing.

The inflatable life-saving swimming garment may be
suitable to fit the swimmer's size. The inflatable part
20 and the inflation system may be worn on an exposed upper
body, without the swimming garment. The inflatable part
may be connected to the gas tank directly by a valve or
indirectly, via a valve and an air pipe. The separated
inflatable parts may be inflated by one or more valves
25 that branch out of the gas tank.

The gas tank may further include a pressure sensor
for sensing the amount of gas remaining. The inflating
system may further comprise an additional valve that is
manually operable by pulling a button loop that is
30 connected to the additional valve by wiring.

The controller may comprise:

a) electrical contacts for providing indication
regarding salt-water and pool water;

- b) a central processing unit (CPU) with software for analyzing the data inserted and received from the inflation system, for processing the data that is inserted and received;
- 5 c) a memory card for saving data related to the swimmer;
- d) a threshold depth-meter display for displaying the depth remains before starting the digital-timer;
- e) a digital-timer display for displaying the time
10 remains before sending the signal to the electronically controlled valve to open;
- f) a depth display for displaying the current depth;
- g) a light button for illuminating the controller whenever desired;
- 15 h) a digital-timer adjusting button for adjusting the threshold time;
- i) a self-test button for testing the inflation system;
- j) a display for operability of the inflation
20 system; and
- l) a battery status display for displaying the current status of the battery.

The depth-meter is adjusted to threshold depth and the digital timer may be adjusted to threshold time.

25 Whenever the inflatable life-saving swimming garment is at, or deeper than, the threshold depth, the CPU sends a signal to the digital timer to start count down. Whenever the inflatable life-saving swimming garment is at the threshold depth and the threshold time lapses, the CPU

30 sends a signal to the electronically controlled valve to open.

The inflatable life-saving swimming garment may further comprise a signaling system, connected to the controller, to signal a swimmer in distress. The signaling system may comprise:

- 5 a) a balloon for signaling the swimmer;
- b) a tank with compressed lightweight connected to the controller for inflating the balloon;
- c) a pipe with a valve such as an
10 electronically controlled valve, for connecting the gas tank to the balloon; and
- d) a LED within the balloon to emit light whenever required.

15 The pipe may contain inside an electrical wire for conveying power to the LED from a battery or from the controller.

20 In one aspect, the signaling system may comprise a Global Positioning System (GPS) unit and a waterproof transceiver assembly, the controller operable to generate a wireless signal by which a user location as sensed by said GPS unit is transmitted to a receiving station for dispatching safety personnel.

25 In one aspect of the first embodiment disclosed on page 5, the user may be a hiker and the life saving operation is the generation of a wireless signal transmitted to a receiving station for dispatching safety personnel when the angle sensed by the orientation sensor is indicative of a predetermined angular deviation that has been sensed within a predetermined period of time.

30 In this aspect, the life saving operation may be the emission of an audible alert to a caretaker, the controller further comprises a sound alert device which is

started when the orientation sensor sends a signal to the controller and the angle is indicative of a predetermined angular deviation for the predetermined time.

5 The present invention is also directed to a user mountable controller for use during sport related activities, comprising:

- a) a controller housing;
- b) means for mounting said housing on a user;
- 10 c) means for setting one or more boundaries of a predetermined range within which a user can safely advance during a sport related activity;
- d) sensor means for sensing when said user has passed outwardly from said one or more boundaries;
- 15 e) a processor in communication with said sensor means, for generating a wireless signal when said user has passed said one or more boundaries and is in actual or impending distress;
- f) means for transmitting said wireless signal.

20 In one aspect, the controller may further comprise means for entering a starting location of the user and a digital timer for measuring time intervals, wherein the processor is operable, based on data sensed by said sensor means, to determine a real time velocity vector which is
25 indicative of motion of the user and for thereby determining a relative location of the user with respect to said starting location during a corresponding time interval.

30 In one aspect, the sensor means may comprise an acceleration sensor and the processor defines an ending time of a time interval as a time when a change in acceleration of the user is sensed.

In one aspect, the sensor means may also comprise an orientation sensor for sensing the direction of the user during the sport related activity, the processor determining a real time velocity vector based on the acceleration sensor and said orientation sensor.

In one aspect, the sensor means may comprise a three-dimensional acceleration sensor for sensing both the magnitude of acceleration and direction of motion of the user during the sport related activity, the processor determining a real time velocity vector based on the magnitude of acceleration and direction of motion.

In one aspect, the sensor means may comprise a GPS unit.

In one aspect, the transmitting means may comprise a transceiver assembly by which the wireless signal is transmitted to a receiving station for dispatching safety personnel.

In one aspect, the transmitting means may comprise a sound alert device for emitting an audible alert to the user.

In one aspect, the transmitting means may comprise a transceiver assembly.

In one aspect, the controller housing and transceiver assembly may be waterproof, and the controller may be mountable on a user disposed in an aquatic environment.

In one aspect, the sport related activity may be swimming and the means for entering a starting location of the user comprises one or more electrical contacts which sense when a swimmer is first submerged in water, the processor being in communication with said one or more contacts and defining the starting location at a location whereat the swimmer is first submerged in water.

In one aspect, the controller may further comprise a depth-meter for measuring the current depth of the user, a depth-meter adjusting button for adjusting a threshold depth, and a digital timer for counting down to a
5 threshold time when the user is submerged deeper than or equal to said threshold depth, whereby the processor transmits a signal to a controllable valve connecting between a gas tank and an inflatable part attached to a garment worn by an upper body part of the user to open
10 when said threshold time lapses and the user is submerged deeper than or equal to said threshold depth.

In one aspect, the sport related activity may be hiking and the processor may be adapted to generate a wireless signal to be transmitted to a receiving station
15 for dispatching safety personnel when the acceleration sensor senses a predetermined increase in acceleration within a predetermined period of time being indicative of a dangerous fall.

In one aspect, the sport related activity may be
20 hiking and the processor may be adapted to generate a wireless signal to be transmitted to a receiving station for dispatching safety personnel when the orientation sensor senses a predetermined angular deviation of the longitudinal axis of said hiker within a predetermined
25 period of time being indicative of a dangerous fall.

The present invention is also directed to a method for ensuring safe advancement of a user during a sport related activity, comprising the steps of:

a) mounting a controller on a user prior to
30 participation in a sport related activity, said controller comprising sensor means for sensing when said user has passed outwardly from one or more boundaries of a predetermined range of advancement and a processor in communication with said sensor

means;

b) setting one or more boundaries of a predetermined range of advancement for the user during a sport related activity;

5 c) indicating a starting location;

d) traversing a distance from said starting location during said activity; and

10 e) transmitting a wireless signal if said processor determines that said user has passed outwardly from said one or more boundaries during said activity.

In one aspect, the sport related activity may be hiking and an audible signal may be emitted to the user if the user strays from a selected trail.

15 Brief Description of the Drawings

In the drawings:

- Fig. 1 is a schematic illustration of an inflatable life-saving swimming garment for children, according to one embodiment of the present invention;
- 20 - Fig. 2a is a front view of the inflatable life-saving swimming garment for children, according to another embodiment of the present invention;
- Fig. 2b is a rear view of the inflatable life-saving swimming garment of Fig. 2a;
- 25 - Fig. 3 is an illustration of the inflation system, according to one embodiment of the present invention;
- Fig. 4 is an illustration of a controller, according to one embodiment of the present invention;

- Fig. 5 is a schematic illustration of an inflatable life-saving swimming garment for children, according to another embodiment of the present invention;
- Fig. 6a is a schematic illustration of an inflatable life-saving swimming garment for toddlers, according to another embodiment of the present invention;
- Fig. 6b is an illustration of a controller, according to another embodiment of the present invention;
- Fig. 7a is a schematic illustration of an inflatable life-saving swimming garment for children with a signaling system, according to another embodiment of the present invention;
- Fig. 7b is an illustration of the signaling system, according to a preferred embodiment of the present invention;
- Fig. 7c is an illustration of the controller, according to another preferred embodiment of the present invention;
- Fig. 8 is an illustration of a controller according to another embodiment of the present invention;
- Fig. 9 schematically illustrates the setting of a predetermined swimming range by means of the controller of Fig. 8;
- Fig. 10 is an illustration of a controller according

- to another embodiment of the present invention;
- Fig. 11 illustrates a method for determining whether a sportsman is advancing within a predetermined range; and
 - 5 - Fig. 12 schematically illustrates the setting of a predetermined hiking range by means of the controller of Fig. 10.

Detailed Description of Preferred Embodiments

10 The inflatable life-saving swimming garment of the present invention comprises an inflatable part that is inflated using an inflation system, attached to it. For brevity, the term "inflatable life-saving swimming garment" and the term "swimming garment" will be used interchangeably in this application to describe the
15 apparatus of the invention.

Fig. 1 is a schematic illustration of an inflatable life-saving swimming garment 10 for children. Swimming garment 10 includes a zipper 11 for easier dressing, and a concealed inflatable part 12 which is attached to the
20 shoulders and waist regions of the garment 10 by any appropriate means. A small air tank 16 that contains compressed air is attached to the inflatable part 12 by an air pipe and an electronically controlled valve (not shown), which is controlled by controller 18.

25 Controller 18 is composed of a depth-meter and a digital-timer (not shown) that are synchronized. The depth-meter measures the water depth by sensing the underwater pressure and converts it into depth units. The depth meter, the digital-timer, and the valve are
30 connected to controller 18 by wiring, and thus function as an integrated device.

Before the child enters the water with swimming garment 10, a self-test is done to verify that the equipment is intact. Afterward, a depth threshold and a

time threshold are adjusted in the depth-meter and in the digital-timer, respectively. The depth threshold is adjusted in accordance with the child's body dimensions. Because of safety considerations, the minimum depth
5 threshold should be the distance between the child's chin and his chest. The minimum time threshold should be adjusted by an adult.

As long as the child wears swimming garment 10 and swims at the water surface level, the depth reading
10 received by the controller 18 is smaller than the adjusted depth threshold. If the child is submerged deeper than the depth threshold, an electronic signal from the depth-meter is sent to the digital-timer through controller 18. The digital-timer starts counting down toward the threshold
15 time and continues, as long as the current depth is deeper or equal to the depth threshold.

When the threshold time has lapsed, an electronic signal is sent to controller 18 from the digital timer. Controller 18 processes the signal from the digital-timer
20 and sends a command in the form of an electronic signal to open the electronically controlled valve. After the electronically controlled valve is opened, the compressed air within air tank 16 expands into inflatable part 12 through the air pipe and inflates it.

25 The upper body part of the child increases its volume in accordance with the volume of inflatable part 12, while the child's lower body part volume remains constant. Thus, the volume difference between the two body parts causes a torque which rotates the child body around its center of
30 mass, i.e. the waist. The child's body rotates around its center of mass point until its longitudinal axis is perpendicular to the water surface level. Therefore, while the inflatable part 12 inflates, the child starts rising up with his head directed up to the water surface level
35 until he floats above it. The upper part of the child's

body is always directed up first, even when, initially, the child's head is directed downwardly, towards the bottom of the body of water.

5 The life saving apparatus of the present invention may be employed whether the child, or an adult user, is totally or partially submerged in ocean water, lake water, swimming pool water, river water, and bath water.

10 An embodiment of the swimming garment of the present invention is shown in Figs. 2a and 2b in front and rear views respectively, and is generally designated by reference numeral 10.

Fig 2a illustrates a swimming garment 10 which comprises an inflatable part 12 around the shoulders part and around the waist part with a small gap for zipper 11 in front, and instant operating button loop 25. Instant operating button loop 25 is installed for cases in which the child who wears swimming garment 10 is in physical distress while swimming. Pulling the instant operating button loop 25 immediately inflates the swimming garment 10. Instant operating button loop 25 is attached to mechanically operated valve 23 by wire 125, as shown in Figs. 2a and 2b. Mechanically operated valve 23 controls the air flow from air tank 16. Air tank 16 is connected to inflatable part 12 by an air pipe 21 that flows through path 123 as shown in Fig. 3. Pulling button loop 25 opens the mechanically operated valve 23 instantly, and the compressed air within air tank 16 expands into inflatable part 12 through path 123 and inflates it. Inflatable part 12 comprises inflatable back-part 112 at the lower back part of swimming garment 10 exploiting maximum inflatable regions. Inflatable back-part 112 and Inflatable part 12 inflates by the same air tank 16 and the same air pipe 21.

As illustrated in Fig. 3, inflation system 30 is an example of a possible arrangement. Inflation system 30 comprises controller 18 for controlling the swimming

garment 10. Air tank 16 comprises compressed air for inflating inflatable part 12, air pipe 21 for conveying the air from air tank 16 to inflating inflatable part 12, electronically controlled valve 22 for keeping the
5 compressed air within air tank 16, mechanically operated valve 23 for instantly operated cases, wiring 122 for conveying the commands from controller 18 toward the electronically controlled valve 22, air tank pressure sensor 24 for announcing about the air amount in air tank
10 16, and wiring 116 for conveying the data concerning air amount in air tank 16 to controller 18.

Fig. 4 illustrates the controller 18 for adjusting and controlling the swimming garment 10. Controller 18 comprises:

- 15 · electrical contacts 41 for operating the system, and for providing indication about saltwater or pool water;
- a digital-timer 142 and its related display for counting down the time for inflating the
20 inflatable part 12;
- depth-meter 144 and its related display which displays the depth remains for starting digital-timer 142,
- a central processing unit (CPU) 43a for
25 controlling inflatable system 30 and processing the received data;
- a memory card 43b for saving the inserted data;
- a current depth display 49 for displaying the current depth;
- 30 · a light button 40 for illuminating the controller 18 at night time;
- a digital-timer adjusting button 42 for adjusting the time threshold;
- a depth-meter adjusting button 44 for adjusting
35 the depth threshold;
- a button 48 for inner test of inflatable system

- 30;
- a display 47 for the operability of inflatable system 30, including two green lights for undamaged inflatable system 30, and a red light (or vice versa);
- a battery for supplying electrical energy, not shown in the figure;
- a battery status display 45 for displaying the current status of the battery;
- a wiring 122 for electrically connecting the controller 18 to electronically operated valve 22;
- a wiring 116 for electrically connecting the controller 18 to air tank pressure sensor 24.

Electrical contacts 41 sense that the child is in aquatic environment with swimming garment 10. Electrical contacts 41 prevent the operation of inflatable system 30 out of the water. While staying in non-aquatic environment electrical contacts 41 enables CPU 43a to operate and to correlate between controller 18 components. In addition, controller 18 senses the resistance between electrical contacts 41. This resistance is analyzed by software within CPU 43a. This software is able to distinguish between pool water and salt-water and a suitable program will operate the swimming garment 10.

Before the child enters the water, a self test of inflation system 30 should be done by pressing self-test button 48. Pressing self-test button 48 sends an electrical signal which tests the intactness of controller 18 and inflation system 30 components. CPU 43a analyzes the data and outputs the test results by means of green light for intact system and red light for improper operation. The green/red light appears on display 47. After checking the operability of the system, the adjustment of the depth threshold and the threshold time is done by means of depth-meter adjusting button 44 and digital-timer adjusting button 42.

CPU 43a analyzes the time and depth adjustments, saves them in memory card 43b using the software installed in the CPU 43a, and displays them on display 142 and 144, respectively. In case when the depth shown in display 144 is zero, thus the depth is the depth threshold or deeper,
5 CPU 43a receives a signal for starting digital timer 142. CPU 43a sends a signal to digital timer 142 which starts counting down the time threshold toward zero.

When the threshold time lapses CPU 43a processes it
10 and sends a signal, through wiring 122, to electronically operated valve 22 to open. Consequently, air from air tank 16 flows into the inflatable part 12 through air pipe 21 and path 121 and inflates inflatable part 12.

All the electronic components introduced hereinabove
15 are waterproofed by a suitable sealing material. This sealing material is attached to garment by any appropriate means such as gluing or sewing.

Swimming garment 10 should provide comfort feeling while wearing it either during swimming or outside the
20 water, just the same as wearing a regular swimming suit. Swimming garment 10 is a re-usable apparatus, i.e. it can be used many times after it has been inflated. Therefore, it requires emptying the air of inflatable part 12 by opening valve 160, and afterwards to repeat the
25 abovementioned process before re-using.

Fig. 5 shows another embodiment of the inflatable life-saving swimming garment 500, which is only an inflatable part 12 connected to inflation system 30. This inflatable part 12 can be worn on a naked or dressed
30 child.

Inflatable life-saving swimming garment 500 comprises an inflatable part 12, a buckle 550 for fastening the inflatable life-saving swimming garment 500, and inflation system 30. Inflation system 30 operates as described

hereinabove and comprises the same components. Inflating part 12 may consist of one or more inflatable parts in case one of them has been punctured. Each inflatable part is connected to the air tank by a corresponding valve.

5 Inflatable life-saving swimming garment 500 is also instantly operable manually by button loop 25, which is connected to the mechanically operated valve and inflatable part 12 within Inflation system 30 by means of wire 125.

10 Figs. 6a and 6b show an inflatable life-saving swimming garment 600 for toddlers, and controller 618. These toddlers are not considered to be swimmers, since they can drown even in a bath without care of an adult. In addition, the steadiness of toddler either when sitting or
15 standing is problematic. Thus, while the toddler enters the water his ability to stabilize himself becomes a difficult action. Consequently, the toddler may fall back or forward into the water easily, without the ability to help himself, unless an adult is in the area to take care
20 of him.

 Therefore, controller 618 herein is upgraded with an orientation sensor 644 instead of the depth-meter used hereinabove. The orientation sensor 644 senses the toddler's deviation from the vertical position, relatively
25 to the water surface level.

 In case the toddler is alone in water and falls forward or backward, the orientation sensor 644 sends two electrical signals, one for starting the digital-timer 142, the other to start a sound alert device (not shown).
30 The digital-timer counts down the threshold time (in this case, a very short time) toward the zero while the sound alert device announces the caring adult about the emergency situation of the toddler. In any event, when the threshold time lapses, the inflatable part 12 inflates and
35 floats the toddler up above the water surface level with

his head directed upwardly.

If desired, the apparatus may employ controller 618 without use of an inflatable part, in order to audibly alert a caretaker when the toddler deviates from a vertical position and his head is in danger of falling into bath water, into swimming pool water, or into sea water. Controller 618 may be mounted on the chest, on an arm, or on any desired bodily part of the toddler. Similarly the apparatus may comprise controller 18 illustrated in Fig. 4 without use of an inflatable part, in order to audibly alert a caretaker that a child swimmer is submerged deeper than or equal to a threshold depth.

Another embodiment of the inflatable life-saving swimming garment is the use of an orientation sensor for children in addition to the depth meter. The orientation sensor detects situations in which the child longitudinal body's axis is at predefined negative angle with respect to the water surface level (with his head directed in the opposite direction to the water surface level) and below it. In case the child is in a predefined negative angle and not at the threshold depth, a signal is sent to the digital-timer to start counting down the time toward the zero. Another case is when the child is at a predefined negative angle and also at the threshold depth, then the timer also gets a signal to start counting down. After the digital-timer has finished counting down, the inflation system 30 will work as already described.

Figs. 7a, 7b and 7c show another embodiment of an inflatable life-saving swimming garment 700. This embodiment discloses signaling system 719 which inflates a colored and lightened balloon that is emitted out of swimming garment 700 for signaling for assistance in a predefined time after the child has sunk below the threshold depth or the angle of his longitudinal axis with respect to the water surface has become greater than a

predetermined angular deviation.

Signaling system 719 comprises wiring 70 for connecting controller 718 to signaling system 719, a tank 76 with compressed lightweight gas (such as helium),
5 electronically operated valve 74 for keeping the gas within the tank 76 in high pressure, predetermined length of rolled up pipe 78 that contains electrical wire within it, a miniature LED 77 and a colored balloon 79. Before the threshold time is adjusted, the timer in signaling
10 system 719 is adjusted by adjusting button 42 and saved in memory card 43b. After the predefined time lapses, an electronic signal is sent to electronically operated valve 74 to open.

After electronically operated valve 74 has been
15 opened, the lightweight gas from tank 76 flows through rolled up pipe 78 to balloon 79 and inflates it. While the lightweight gas flows through the rolled up pipe 78, the compressed gas causes balloon 79 to inflate and simultaneously to jump out of the swimming garment 700.
20 When electronically operated valve 74 receives the electronic signal to open, electrical current flows through an inner electric wire located inside pipe 78 and lights LED 77. Consequently, the distressed child is signaled by a lightened and colored balloon which enables
25 the lifeguard to save the child's life before the inflatable part 12 inflates and by that saving very important time. In case the lifeguard or any other adult has not noticed the distressed child, the inflatable part 12 will inflate after the predefined threshold time and
30 will float the child up above the water surface level.

The signaling system may also comprise, as shown in Fig. 8, a Global Positioning System (GPS) unit 847 and a waterproof transceiver assembly 849, which are mounted in controller 818. If a child swimmer, for example, has swum
35 for a predetermined period time stored in CPU 843 and his

whereabouts are unknown, the CPU generates a signal S that is indicative of the instantaneous location of the swimmer as determined by GPS unit 847 and commands transmitting assembly 849 to transmit signal S to a receiving station, whereupon safety personnel are dispatched to retrieve the swimmer. A balloon may also be emitted a predetermined time after signal S has been transmitted, to further assist in locating the swimmer.

By means of GPS unit 847, the swimmer or a caretaker thereof can set a predetermined swimming range within which the swimmer can safely swim without concern of being in danger, of being in risk of danger, or of being excessively tired. Various buttons such as buttons 831-833 may be used to set the predetermined swimming range. For example, function button 831 may be used to select a desired function, such as starting location, range in the x-direction, and range in the y-direction. By continuously depressing button 832, a numerical value is adjusted on display 839 and may then be entered into the memory of CPU 843 by means of button 833. The starting location may be automatically entered by means of electrical contacts 41 (Fig. 4), which sense when the swimmer is first submerged in the water, whereupon CPU 843 receives from GPS unit 847 the starting location. The buttons may be locked by depressing a predetermined sequence of buttons, or by mechanical means. Alternatively, the predetermined swimming range may be set by transmitting a wireless signal T to transceiver 849 from an external electronic device. When the swimmer swims beyond the predetermined swimming range as detected by GPS unit 847, CPU 843 generates a signal S which is transmitted to a receiving station.

Fig. 9 schematically illustrates the utility of controller 818 shown in Fig. 8. When the waterproof controller is mounted on the body of a child swimmer 821 or on a swimming garment worn by swimmer 821, the

caretaker enters a predetermined swimming range R, e.g. tens of meters, from a starting point 819 which is indicative of an estimated range within which swimmer 821 can safely swim without concern of being swept away into deeper water by undertow 829. Since swimming range R is generally estimated as being perpendicular to beach shore 827, the caretaker enters the X and Y values from starting point 819 which correspond to range R.

It will be appreciated that an experienced swimmer can enter a much longer range on the order of hundreds of meters or several kilometers which corresponds to a known personal fatigue level or a known danger zone. A signal may be transmitted from the controller, which may be worn on the wrist, to a receiving station to initiate a rescue operation when the swimmer swims beyond the predetermined range, as determined by the CPU in conjunction with the inputs received from the GPS unit. Alternatively, an audible signal is transmitted to the swimmer after swimming beyond the predetermined range in order to be alerted that his swimming direction should be changed.

Fig. 10 illustrates another embodiment of the invention wherein controller 848 can determine whether a swimmer has swum beyond a predetermined range without use of a GPS unit. In this embodiment, waterproof controller 848 comprises an electronic acceleration sensor 856 for sensing the instantaneous acceleration of the swimmer, digital timer 142 for determining the duration of each change in acceleration, and an electronic orientation sensor 644 for sensing the instantaneous direction of the swimmer. Alternatively, acceleration sensor 856 may be a three-dimensional acceleration sensor from which the instantaneous direction may be derived, rendering a separate orientation sensor unnecessary. CPU 843 is therefore able to compile an accumulated log of motion of the swimmer, including direction and velocity, so that the instantaneous location of the swimmer can also be

determined. When the swimmer swims beyond a predetermined swimming range as set by buttons 831-833, CPU 843 generates a signal S, which may be transmitted to a receiving station to initiate a rescue operation, or
5 alternatively, may be transmitted to the swimmer himself.

A method for determining the instantaneous location of a swimmer by means of an electronic acceleration sensor is illustrated in Fig. 11. After the starting location of the swimmer is indicated in step 73 by means of buttons
10 831-833 (Fig. 10) or by means of electrical contacts 41 (Fig. 4) for sensing when the swimmer is first submerged in the water, the predetermined range relative to the starting location is entered in step 75 by means of buttons 831-833 or by means of an external electronic
15 device. When the swimmer starts to swim in step 77, his acceleration increases and is sensed by the acceleration sensor in step 79. The CPU then determines his velocity in step 81 for the duration between starting time t_0 and time t_1 , at which time his acceleration changes. Since the
20 direction of the swimmer is also known between time t_0 and time t_1 and is received in step 83, the CPU calculates the velocity vector during the given time interval. The distance traversed by the swimmer from the starting location, which is derived from the velocity vector, is
25 also calculated, and therefore the CPU determines in step 85 the location of the swimmer at time t_1 relative to the starting location.

The CPU repeats in step 87 this procedure for each subsequent time interval during which the acceleration of
30 the swimmer changes from a previous time interval. If for example, the acceleration of the swimmer is zero, the CPU determines that the swimmer is advancing at a constant velocity, and the previously determined velocity vector is extended for the given time interval and the relative
35 location of the swimmer is adjusted, until an additional change in acceleration is sensed. If, however, an

acceleration of zero is sensed following a time interval during which the sensed acceleration was negative, the CPU determines that the swimmer has stopped swimming and his relative location will therefore not be adjusted for that
5 time interval.

A signal, whether transmitted to a receiving station to initiate a rescue operation or to the swimmer himself, is generated in step 89 when the instantaneous relative location of the swimmer is such that it is indicative that
10 the swimmer has passed the predetermined range.

It will be appreciated that a balloon may be emitted, a predetermined time following generation of the signal, from a swimming garment worn by the swimmer by means of the signaling system illustrated in Fig. 7b, to assist in
15 locating the swimmer. Additionally, an inflatable part attached to the swimming garment may be inflated when the CPU determines that the swimmer is submerged deeper than or equal to a previously set threshold depth.

In another embodiment of the invention, the
20 previously described life saving apparatus may be used by a hiker.

As shown in Fig. 12, a hiker 861 may employ controller 618 illustrated in Fig. 6b, controller 818 illustrated in Fig. 8, or controller 848 illustrated in
25 Fig. 10 when advancing on a trail, such as climbing mountain 872. The controller may be mounted on a body part or on the clothing of hiker 861, or may be attached to a dedicated garment worn by the hiker. An emergency signal S will be generated by the controller and will be
30 transmitted to a receiving station if hiker 861 falls a predetermined depth within a predetermined period of time, as sensed by acceleration sensor 856, GPS unit 847, or by a suitable altitude sensor, or if the angle of the longitudinal axis of the hiker with respect to a
35 horizontal plane changes by predetermined angular

deviation within a predetermined period of time, as sensed by orientation sensor 644 or a three-dimensional acceleration sensor 856.

Hiker 861 may also employ the apparatus to set a
5 predetermined range R while advancing on a trail 873, to advantageously determine whether he is advancing in the correct direction or whether he has strayed from the trail. Hiker 861 may enter the X and Z values, and if needed, the Y values, corresponding to range R from
10 starting point 869, and the method illustrated in Fig. 11 may be performed in order to determine whether he is advancing within the boundaries which he entered. Hiker 861 may also enter a selected deviation value, to take into account an accepted level of human error. If the
15 predetermined range is passed, hiker 861 will be alerted that he is advancing in an incorrect direction, and that he is to search again for trail 873.

It will be appreciated that GPS unit 847 may also be used to determine whether the hiker has strayed from the
20 trail. It will also be appreciated that any other person involved in a sport related activity can employ the apparatus of the invention to determine whether he is advancing within a predetermined range.

While some embodiments of the invention have been
25 described by way of illustration, it will be apparent that the invention can be carried out with many modifications, variations and adaptations, and with the use of numerous equivalents or alternative solutions that are within the scope of persons skilled in the art, without departing
30 from the spirit of the invention or exceeding the scope of the claims.

In the claims which follow and in the preceding description of the invention, except where the context requires otherwise due to express language or necessary
35 implication, the word "comprise" or variations such as

"comprises" or "comprising" is used in an inclusive sense, i.e. to specify the presence of the stated features but not to preclude the presence or addition of further features in various embodiments of the invention.

- 5 It is to be understood that, if any prior art publication is referred to herein, such reference does not constitute an admission that the publication forms a part of the common general knowledge in the art, in Australia or any other country.

THE CLAIMS DEFINING THE INVENTION ARE AS FOLLOWS:

1. Life-saving apparatus comprising:
 - a) an inflatable part attached to a garment worn by an upper body part of a user disposed in an aquatic environment, for causing said user to float while being in distress such that his head is upwardly directed, and for creating, when inflated, a volume difference between the upper body part and a lower body part; and
 - b) an inflating system, which comprises:
 - i. a gas tank with compressed gas for inflating, whenever required, said inflatable part;
 - ii. a controllable valve connecting between said gas tank and said inflatable part, for allowing, whenever required, said compressed gas to inflate said inflatable part;
 - iii. a waterproof electric or electronic controller for analyzing data related to said user and for opening said valve after said user has been in an actual or impending distress for a predetermined time;
 - iv. an orientation sensor for sensing an angle of the longitudinal axis of said user with respect to a horizontal plane and for sending a first signal to said controller to open said valve when said angle is indicative of a predetermined angular deviation for a first predetermined threshold time;
 - v. a digital timer;
 - vi. a processing unit for receiving data from said timer and for sending a second signal to said valve to open when a threshold time lapses;

- vii. a depth-meter for measuring a current depth of said user and a depth-meter adjusting button for adjusting a threshold depth, said timer counting down to said first threshold time after the predetermined angular deviation has been sensed or down to a second threshold time when said user is submerged deeper than or equal to said threshold depth, whereby said processing unit sends said second signal to said valve to open when said second threshold time lapses and said user is submerged deeper than or equal to said threshold depth or when said first threshold time lapses and said angle of the longitudinal axis of said user with respect to the water surface is indicative of said predetermined angular deviation; and
- viii. a battery for supplying electrical power for the operation of said inflating system.

2. The life-saving apparatus according to claim 1, wherein the controller further comprises a display for displaying the time remaining before the second signal is sent to the valve, and/or a digital-timer adjusting button for adjusting a threshold time, and/or a battery status display for displaying the current status of the battery, and/or a memory card for saving data related to the user, and/or a light button for illuminating the controller whenever desired.
3. The life-saving apparatus according to claim 1, wherein the controller further comprises a self-test button, which when pressed, sends a third signal to the processing unit for testing controller and inflation system intactness, and an operability display for

indicating the intactness of the controller and of the inflation system.

4. The life-saving apparatus according to claim 1, wherein the controller further comprises a depth display for displaying the current depth of the user and a threshold depth-meter display for displaying the depth remaining before starting the digital timer.
5. The life-saving apparatus according to claim 1, wherein the controller further comprises one or more electrical contacts for sensing that the user is in the aquatic environment and for preventing operation of the inflating system when the user is not in the aquatic environment.
6. The life-saving apparatus according to claim 5, wherein the processing unit is adapted to distinguish between pool water and salt water.
7. The life-saving apparatus according to claim 1, further comprising a sound alert device for emitting an audible alert to a caretaker, said sound alert device being started when the orientation sensor sends a fourth signal to the controller and the angle is indicative of a predetermined angular deviation for the predetermined time.
8. The life-saving apparatus according to claim 1, wherein the inflatable part is attached to the garment by gluing or sewing; or the size of the garment is adjustable; or the inflatable part or the inflation system is worn on an exposed upper body.

- 2009222455 24 Oct 2012
9. The life-saving apparatus according to claim 1, wherein the inflatable part comprises a plurality of separated inflatable sections.
 10. The life-saving apparatus according to claim 9, wherein the inflatable part is connected to the gas tank directly by a valve or indirectly, via a valve and an air pipe.
 11. The life-saving apparatus according to claim 9, wherein the separated inflatable parts are inflated by one or more valves that branch out of the gas tank.
 12. The life-saving apparatus according to claim 1, wherein the gas is air or CO₂.
 13. The life-saving apparatus according to claim 1, wherein the gas tank further includes a pressure sensor for sensing the amount of gas remaining therein.
 14. The life-saving apparatus according to claim 1, further comprising a manually operable valve for controlling the flow of compressed gas from the gas tank to the inflatable part, and a button loop connected to said manually operable valve by a wire, whereby the inflatable part is instantly inflated when said button loop is pulled.
 15. The life-saving apparatus according to claim 1, wherein the orientation sensor sends the first signal when sensing a predetermined negative deviation angle such that the head of the user is downwardly directed.

2009222455 24 Oct 2012

16. The life-saving apparatus according to claim 2, further comprising a signaling system connected to the controller, in order to save a user in distress.
17. The life-saving apparatus according to claim 16, wherein said signaling system comprises:
- a) a tank with compressed lightweight gas;
 - b) an electronically operable valve connected to said controller, for controlling flow of said lightweight gas;
 - c) a balloon inflatable by said lightweight gas; and
 - d) a pipe connecting said gas tank to said balloon by means of said electronically operable valve,
- wherein the controller is adapted to open said electronically operable valve by a fifth signal and to thereby cause said balloon to be emitted from the garment at a third threshold time after the predetermined angular deviation has been sensed and being before the first threshold time, said third threshold time being adjusted by means of the digital-timer adjusting button.
18. The life-saving apparatus according to claim 17, wherein a light emitting diode (LED) is disposed within the balloon and the pipe contains an electrical wire for conveying electrical power to said LED, said LED being lit after the fifth signal is sent and causing a lit balloon to be emitted from the garment.
19. The life-saving apparatus according to claim 16, wherein the signaling system comprises a Global Positioning System (GPS) unit and a waterproof transceiver assembly, the controller operable to generate a wireless signal by which a user location as sensed by said GPS unit is

transmitted to a receiving station for dispatching safety personnel.

2009222455 24 Oct 2012

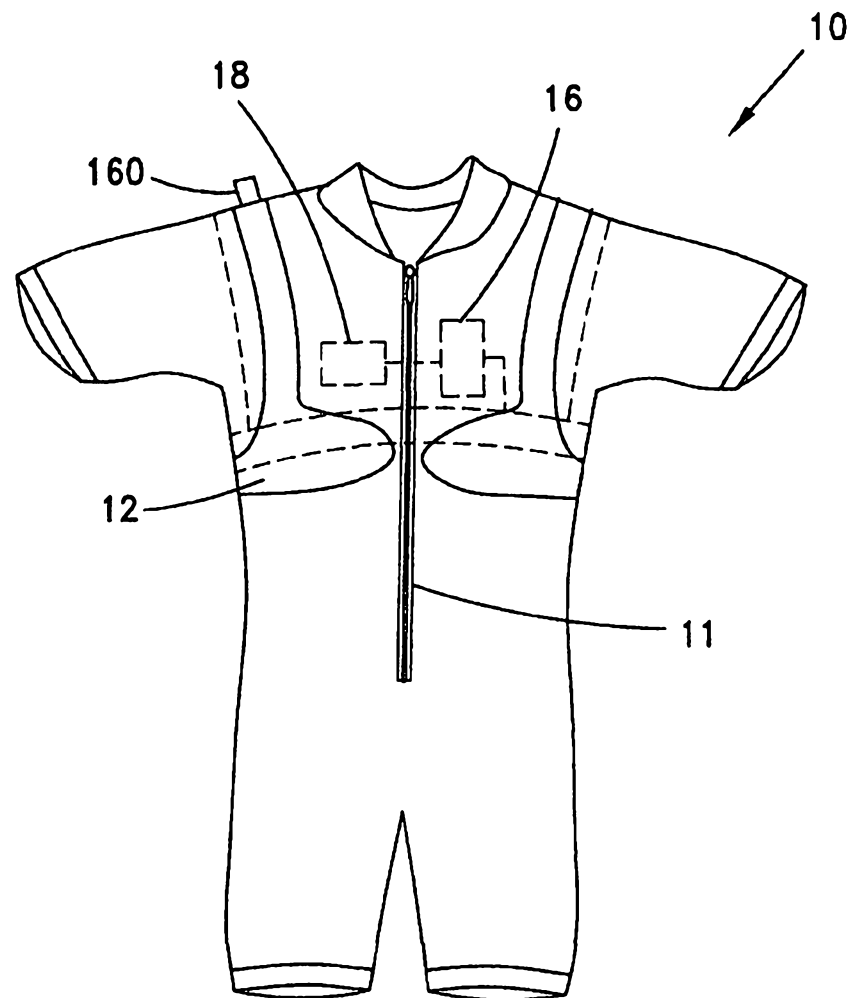


Fig. 1

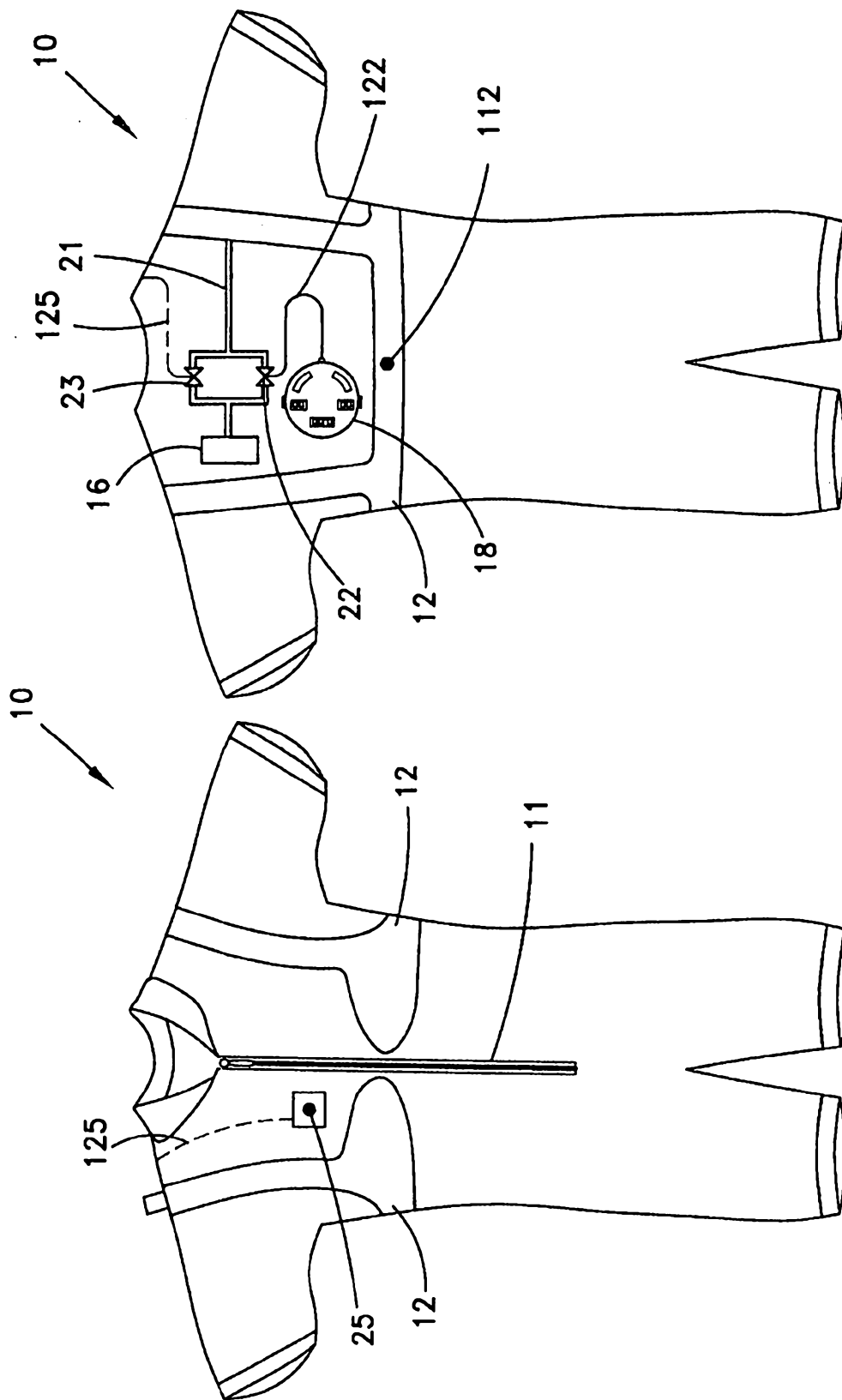


Fig. 2b

Fig. 2a

3/12

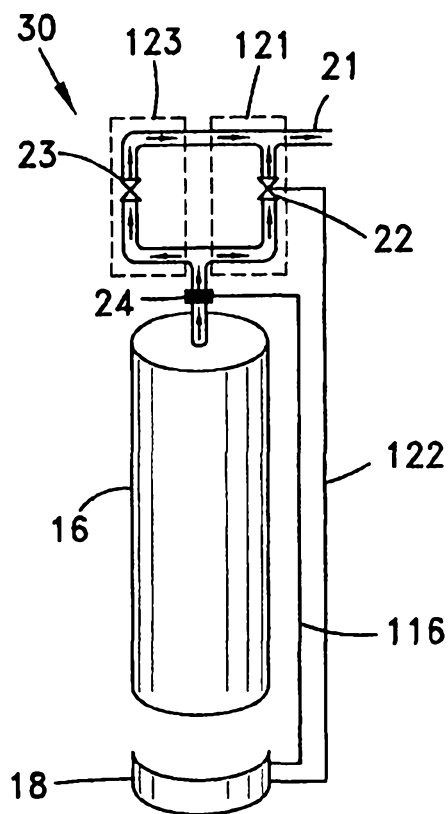


Fig. 3

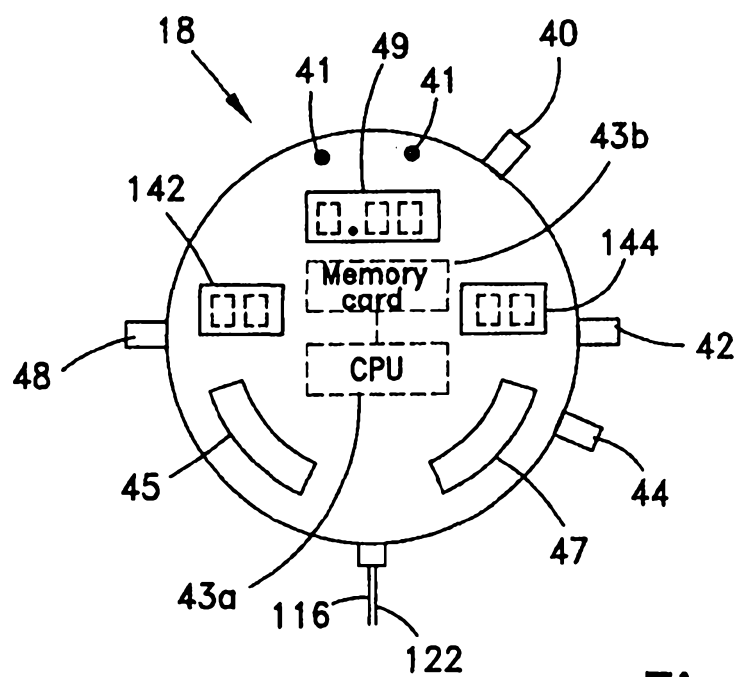


Fig. 4

4/12

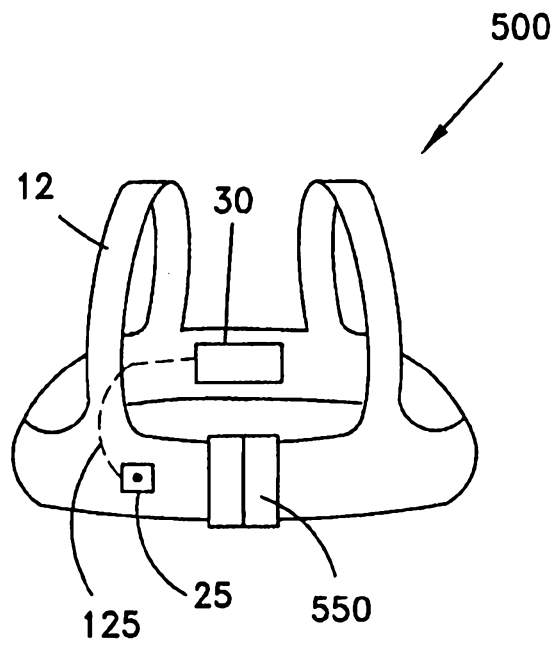


Fig. 5

5/12

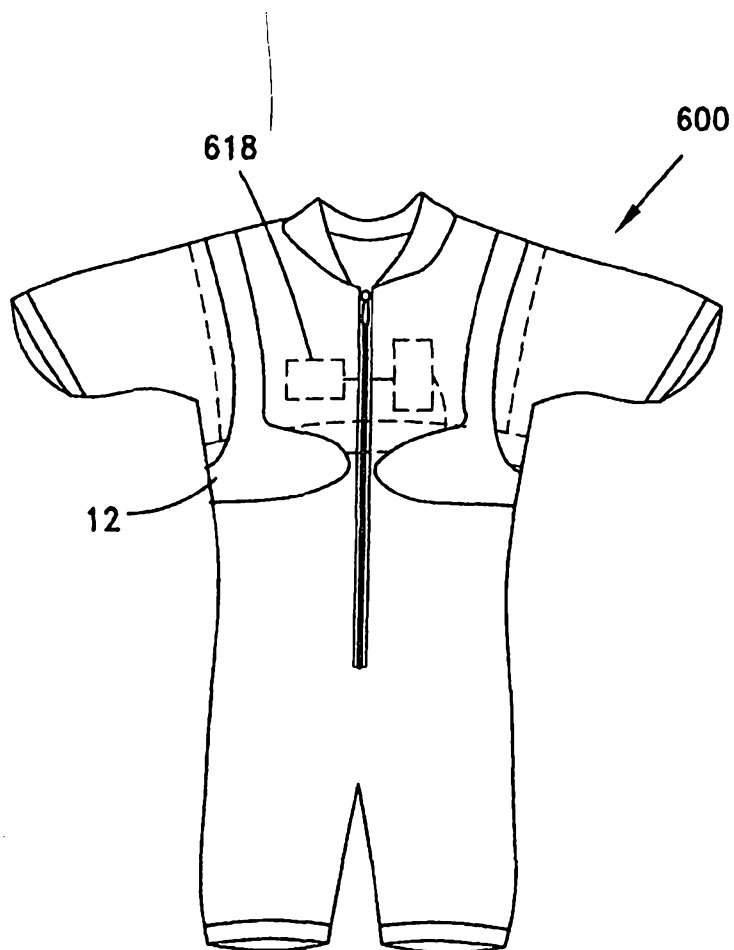


Fig. 6a

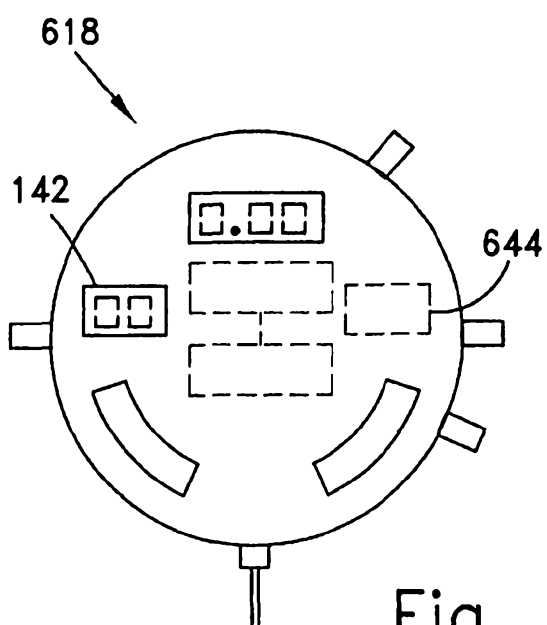


Fig. 6b

6/12

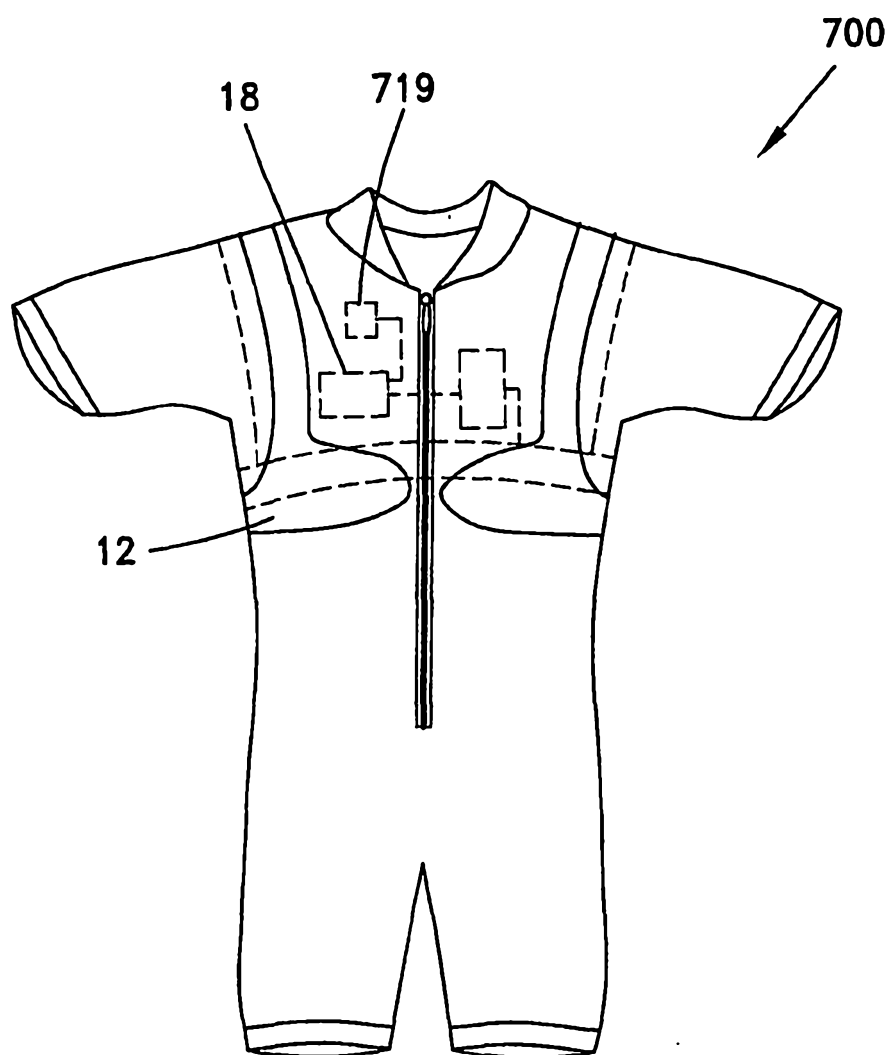


Fig. 7a

7/12

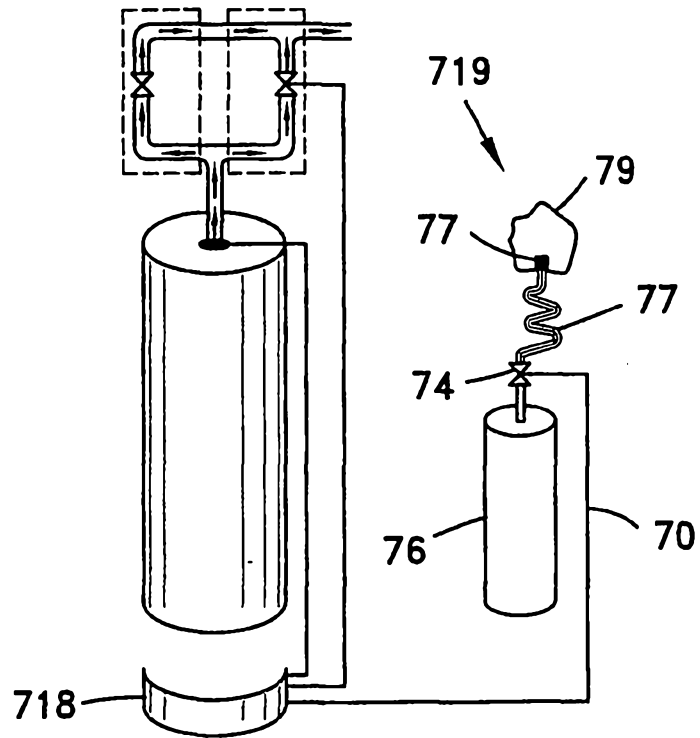


Fig. 7b

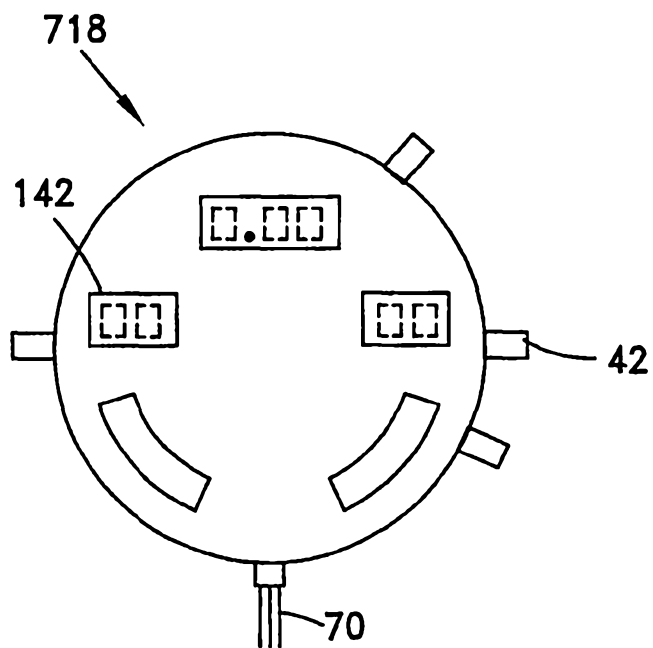


Fig. 7c

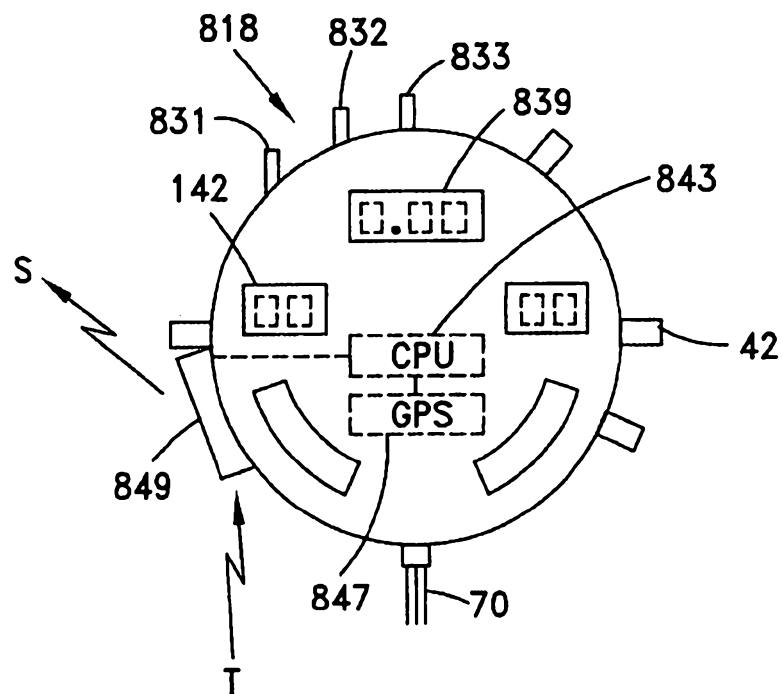


Fig. 8

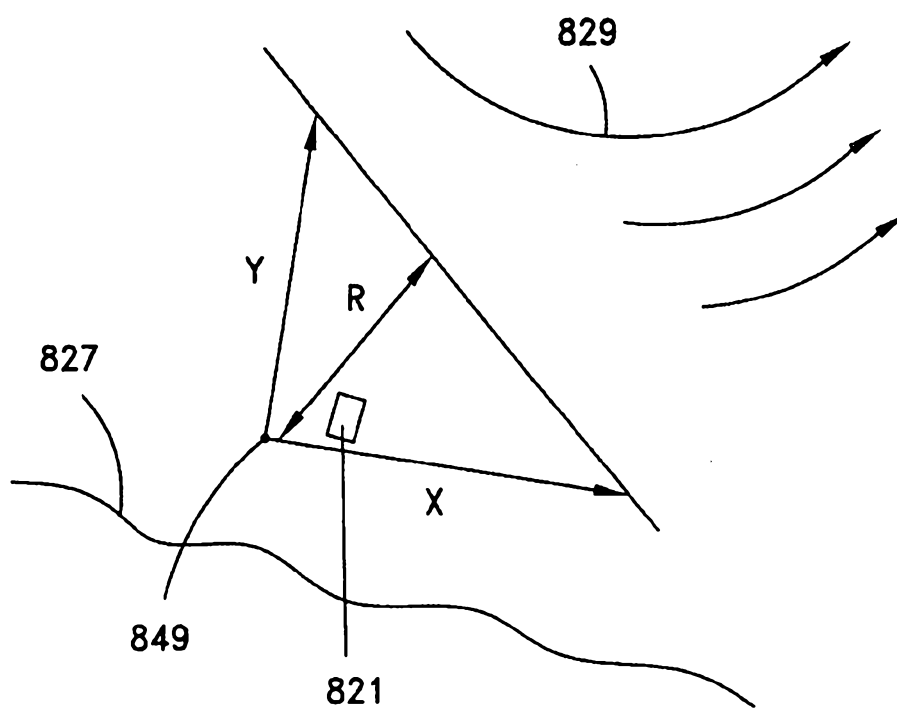


Fig. 9

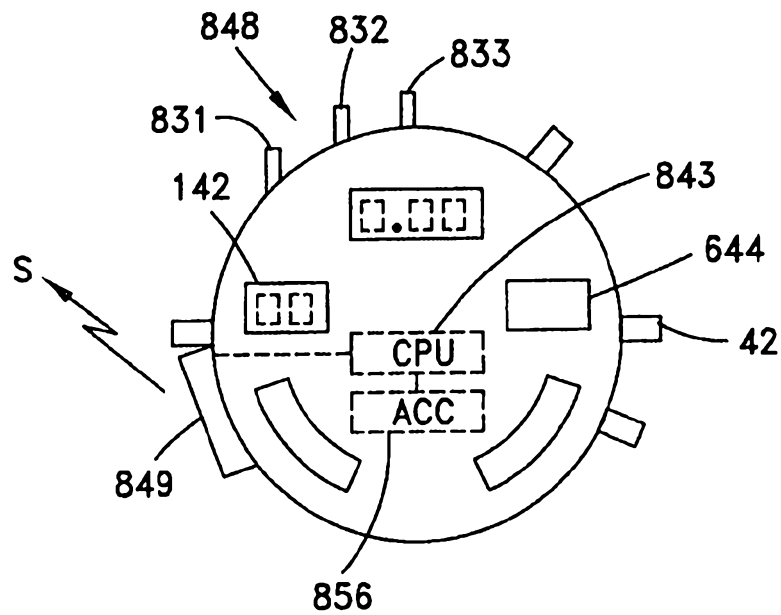


Fig. 10

11/12

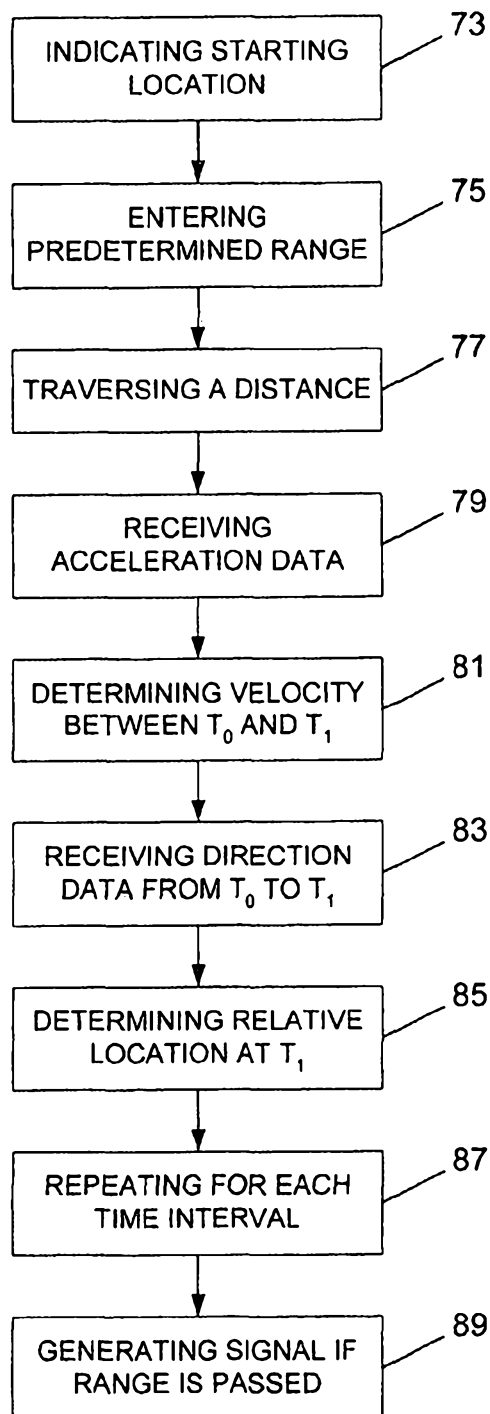


Fig. 11

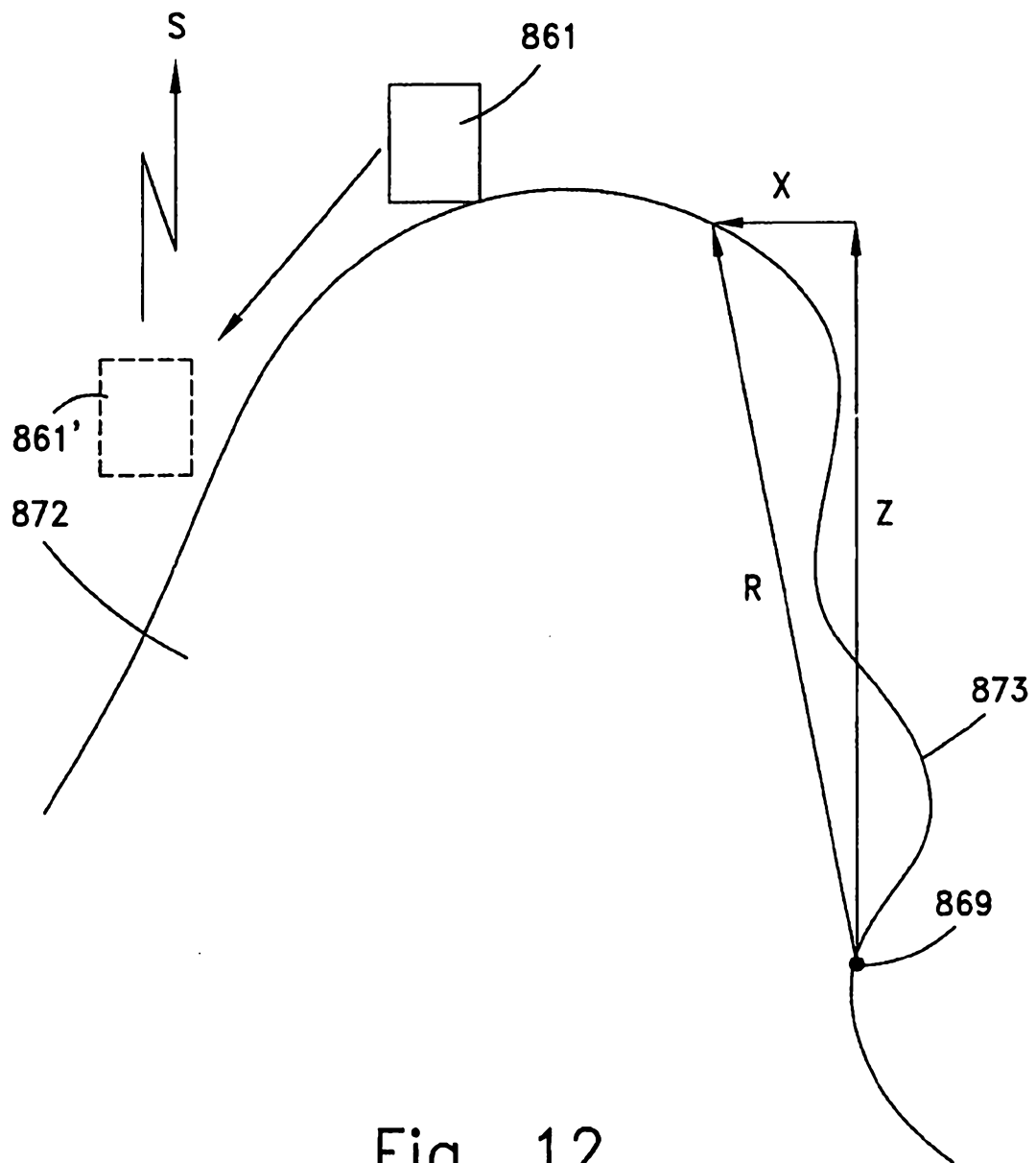


Fig. 12