A safety device for keeping a vessel afloat, for use within a vessel, to prevent the sinking of the vessel; the safety device comprising an air inflatable air and water impervious float (11) characterized by comprising a water and air impermeable skin enveloping an expandable air-chamber having an air intake (18).
Published:
— with international search report

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.
WATERCRAFT ANTI-SINKING DEVICE

FIELD OF THE INVENTION

The present invention relates to a safety device for preventing vessels from sinking.

BACKGROUND OF THE INVENTION

A buoyant force is exerted on an object submerged in a fluid. Archimedes' principle states that when an object is partially or fully submerged in a fluid, the buoyant force, or apparent loss in weight, is equal to the weight of the fluid displaced, and a floating object displaces its own weight of fluid. This principle is widely applied in the construction of yachts and other vessels, where a waterproof construction is used to enclose an air filled chamber or hull, and the vessel finds its level; it floats at a depth such that the weight of water displaced balances the weight of the boat.

When vessels floating in water suffer damage to their hulls by being run aground for example, or scraped on rocks, or when such vessels list heavily or capsize, water may fill the chamber, and the vessel will sink, unless appropriate action is taken to prevent such an occurrence.

This problem of vessels inadvertently sinking has been addressed in the past several times. Most prior art solutions involve one or more inflatable, air and water impermeable skins connected to a high pressure gas cylinder which serves as a means of inflation. High pressure gas cylinders, or bombs as they are sometimes called, have many disadvantages which limit the attractiveness and general viability of these prior art solutions:

Firstly, when the gas is discharged from a high pressure gas cylinder, the gas discharge rate varies with the environmental temperature. Consequently, the time required for inflating an inflatable float by means of a high-pressure gas cylinder varies throughout the daily cycle and seasons. The time to inflate also varies with the geographical location of the boat fitted therewith, and since ocean going pleasure craft may travel over many latitudes, the difference in the environmental temperature at the time of discharge may vary over very wide ranges. This can result in delayed response, and failure of the system.

Secondly, the high pressure gas cylinder’s temperature drops as gas is discharged therefrom. High pressure gas cylinders are often filled with carbon dioxide gas, which, because of its inertness and price is a favourite for such applications. Consequently, the gas discharge rate decreases as the cylinder cools, and, in the worst case, part of the gas solidifies into dry ice, thereby practically stopping the further discharge of gas and causing
clogging of the gas outlet. Such phenomena are clearly not desirable, since, to be effective, inflatable floats must be inflated quickly in an emergency case such as shipwreck.

Thirdly, the temperature at which high pressure gas cylinders are used or stored may reach as high as several tens of degrees centigrade due to exposure to the sun. Under these conditions the internal pressure of the high pressure gas cylinders or bomb may become dangerously high, necessitating such high pressure gas cylinders being under-pressurized, and / or having extra thick walls, increasing the weight thereof. High pressure gas cylinders have been known to explode. This may be dangerous to personnel, and the damage resulting from such an event on board a yacht or similar small craft may be very costly, and may even be serious enough to sink the vessel.

Fourthly, to prevent such explosions, high pressure gas cylinders are designed in accordance with a leak-before-break criterion. Consequently, gas tends to gradually leak from high pressure gas cylinders when stored on a ship for a long time, and it is possible that the high pressure bomb will not hold a sufficient amount of gas therein for inflating the inflatable floats in an emergency.

Fifthly, high pressure gas cylinders require stringent maintenance that includes regular visual inspection and a trial 150% over-inflation once every 5 years. Such maintenance is costly, time consuming and an undesirable hassle for the owners of small vessels.

Sixthly, high pressure air cylinders are both bulky and heavy. To keep a tonne of ship afloat, a tonne of water must be displaced. This requires a float having a volume of a cubic meter. A cylinder pressurized to 200 atmospheres capable of inflating a cubic meter float will itself have a volume of 5000 cm$^3$, and will weigh several kilograms. Even relatively small pleasure craft may weigh 4-6 tonnes, and a series of gas cylinders designed to fill the 4-6 m$^3$ of inflatable floats required to keep such a vessel afloat, is costly, bulky, heavy and unaesthetic. These disadvantages, when coupled to the maintenance requirements and the inherent dangers associated with high-pressure gas cylinders, go a long way to explain why such systems have never really caught on.

Among prior art systems in this crowded art, are US 5,357,888 to D. E. Insinna which describes an emergency floatation system for a water craft, that includes an elongated inflatable buoyancy tube positioned within an interior volume defined by a contour molded
cover whose perimeter is sealingly mated around a somewhat flat base member against the outer surface of the hull. The emergency flotation system described in this publication essentially requires the water craft to which it is fitted to be designed around the system. It is not retrofittable to standard boats and operates on compressed gas, with all the inherent disadvantages described hereinabove.

US 4,817,555 to Meinen describes a ‘Boat flotation collar’ wherein a generally "U" shaped upwardly oriented bumper guard is positioned longitudinally of a boat and attachable thereto. Within the upstanding "U" shaped bumper guard is an inflatable bag or series of bags that are connected to a compressed gas bottle, and inflated therefrom. Apart from being directly inflated by compressed gas, the bumper guard will is more of an impact preventing air-bag than a floatation means. Being external to the boat, the device described is hardly aesthetic.

WO 0029284 to Gomez Portela, describes a system for keeping afloat any type of boat in case of a leak. Although suitable for various boats, the inflatable elements described therein are placed externally to the hull of the vessel, and the result is thus inherently unaesthetic. Furthermore this system, like the others described hereinabove, includes compressed gas cylinders which are heavy, somewhat dangerous, require fairly intensive maintenance and are inherently expensive.

The present invention provides a cost effective, safe, easy to use and maintain floatation system that is retrofittable to existing vessels, and overcomes the disadvantages of the devices and systems of the prior art.

**SUMMARY OF THE INVENTION**

According to the present invention, there is provided a safety device for keeping a vessel afloat, for use within a vessel, such as a yacht or boat, for example, to prevent the sinking thereof after damage thereto; the safety device comprising an air inflatable air and water impervious float characterized by comprising a water and air impermeable skin enveloping an expandable air-chamber having an air intake and a skeletal structure; the skeletal structure having an expanded state and a contracted state.

In some embodiments, the skeletal structure is a mechanical skeletal structure that can alternately be extended to said expanded state or folded to said contracted state.
Optionally, the mechanical skeletal structure folds and extends on a lazy-tongs principle.

Alternatively, the mechanical skeletal structure comprises a plurality of hoops; each hoop being foldable into a figure-of-eight configuration, for compaction purposes, and releasable into an ovoid loop; said plurality of hoops, when expanded, enclosing a volume.

Preferably, the skin is fabricated from soft PVC and said air intake includes a one-way soft valve.

Alternatively, the skeletal structure is a gas-fillable skeletal structure, and the air and water impervious float safety device additionally comprises a source of gas and a triggering device.

Optionally, the gas-fillable skeletal structure comprises elongated air cells.

The source of gas may include a gas cylinder of compressed gas.

Alternatively, the source of gas may include reactive, nitrogen generating chemicals for inflating said air and water impervious float safety device, and a trigger means for triggering the inter-reaction of said nitrogen generating chemicals.

Nitrogen generating chemicals may include sodium azide and manganese IV oxide and /or zinc carbonate, and /or sodium azide and potassium perchlorate and /or barium azide and potassium perchlorate, and / or ammonium perchlorate and unsaturated polyester resin.

The triggering means may be selected from the list of chemical triggering means, mechanical triggering means and electronic triggering means, and in some embodiments the triggering means includes an ignition device having a rotary mechanism for bringing a friction means into contact with a frictional igniting agent.
BRIEF DESCRIPTION OF THE DRAWINGS

The present invention will be further understood and appreciated from the following detailed description taken in conjunction with the drawings in which:

Fig. 1 is a schematic illustration of an inflatable, float safety device for a vessel, in accordance with a first embodiment of the present invention, characterized by having a mechanical expansion means consisting, at least in part, of telescopic rods.

Fig. 2 is a schematic side-view illustration of an inflatable float safety device for a vessel, having a mechanical expansion means according to a second embodiment of the present invention, consisting at least in part, of a lazy tongs device.

Fig. 3 is a schematic side-view illustration of an inflatable, float safety device having a gas-expandable skeletal structure, according to a third embodiment of the present invention, wherein the gas-expandable skeletal structure consists of interconnected cells connected to a gas cylinder.

Fig. 4 is a schematic side-view illustration of an inflatable, air and water impervious float safety device having a gas-expandable skeletal structure, according to a fourth embodiment of the present invention, wherein the gas-expandable skeletal structure consists of one or more sealed cells containing gas-releasing chemicals, and a trigger device for triggering a reaction of the gas releasing chemicals to release gas.

Fig. 5 is a schematic side-view illustration of a inflatable, float safety device, that is gas inflatable, containing gas-releasing chemicals, and a trigger device for triggering a reaction of the gas releasing chemicals to release gas.

Fig. 6a shows an exemplary inflatable, float safety device for a vessel, in accordance with the first embodiment, shown schematically in Fig. 1.

Fig. 6b shows the skeletal structure of the device of Fig. 6a in expanded configuration.

Fig. 6c shows the device of Fig. 6a in compacted (storage) configuration, folded down to a disc.

Fig. 6d shows a plurality of the devices of Fig. 6a in compacted (storage) configuration shown in Fig. 6c, stacked into a storage sleeve.

Fig. 7 shows a damaged boat having a plurality of expanded float devices of the invention, arranged within the hull thereof.
DETAILED DESCRIPTION OF THE INVENTION

The present invention is directed to an air-inflatable, air and water impervious float safety device for use within a vessel, to prevent the sinking of the vessel after damage thereto. The air inflatable float safety device consists of a water and air impermeable skin surrounding an expandable air-chamber having an air intake and a skeletal structure that is able to alternatively adopt an expanded state and a contracted state. The expansion of the skeletal structure from the contracted state to the expanded state forces the expandable air-chamber of the air-inflatable, air and water impervious float device to expand, sucking air through the air intake thereof, and thus filling the air chamber with air. Since the main volume of the float device is inflated with regular air, using the air surrounding the vessel, there is no need to provide a quantity of bottled gas that at standard temperature and pressure (STP) can displace a quantity of water equal to the weight of the vessel. Consequently, the need for bulky, heavy, dangerous bottled gas cylinders is largely or totally eliminated.

With reference now to Figure 1, in accordance with a first embodiment, there is provided an inflatable float 10 consisting of an impermeable skin 11 surrounding a skeletal structure 12, the skin 11 enveloping an expandable air chamber 14. the skeletal structure 12 is able to alternatively adopt an expanded state or a contracted state, and may be expanded to cause the air chamber 14 of the air-inflatable, air and water impervious float device 10 to expand, sucking air through the air intake 18 thereof. The mechanical skeletal structure shown is constructed from folding horizontal members 13 hinged at their corners to each other and to telescopic vertical rods 16, such as commonly used for the antennae of FM radios, and the like. The skeletal structure 12 can be folded up and contracted for storage in a small space, but may be expanded outwards, drawing air through the air intake 18 of the air device 10, into the air chamber 14 thereof, thus inflating the skin thereof. Once inflated, the air intake may be sealed or stoppered by a sealing means 19, to prevent the air from leaking out. Additionally, the intake 18 may include a one-way valve or similar.

As shown in Figure 2, in accordance with a second embodiment, there is provided an inflatable float 20 consisting of an impermeable skin 21 surrounding a skeletal structure 22, the skin 21 enveloping an expandable air chamber 24. In this second embodiment, the skeletal structure 22 is a mechanical skeletal structure constructed on a lazy-tongs principle.
The skeletal structure 22 is able to alternatively adopt an expanded state or a contracted state, and when expanded, will cause the surrounding skin 21 of the air chamber 24 of the air-inflatable, air and water impervious float device 20 to expand, sucking air through the air intake 28 thereof. Once the float device 20 is expanded, the air intake may be closed off using a sealing means 29.

Figures 1 and 2 illustrate simple mechanical devices that may be used to create a rapidly expandable skeletal structure that can open an air-inflatable float device. These are merely exemplary embodiments incorporating compact mechanical skeletal structures that are easily expandable, and having disclosed the concept of an air-filled float that has a collapsible, expandable mechanical structure, many alternative mechanical structures will now suggest themselves to the designer or engineer addressing the problem of creating a collapsible skeletal structure for a float device of this nature. The basic requirement for the skeletal structure is that it should be compact in a collapsed state and easily and quickly expandable into a voluminous three dimensional expanded structure. Preferably, the device will automatically lock open, or at least resist being collapsed. However, since the air chamber of the air-inflatable, air and water impervious float device is constructed to prevent air leaking out, at least for a period of a few days, the air sucked into the expanded air chamber will itself prevent the device from collapsing, hence such a locking device is not generally essential.

With reference now to Figures 3 and 4, in accordance with third and fourth embodiments of the present invention, there are shown an air inflatable, air and water impervious float safety device 30 having a gas-fillable skeletal structure 32 attached to a skin 31 surrounding an air-fillable chamber 34. This inflatable float safety device 30 is connected to a source of gas and a triggering device, and provides an emergency system.

The gas-fillable skeletal structure 32 typically comprises a framework of elongated gas cells 33.

With specific reference now to Figure 3, the framework 32 of elongated gas cells 33 are interconnected and the source of gas is a reservoir of bottled gas 35, such as a gas cylinder of nitrogen or carbon dioxide for example. In contradistinction to the gas filled floats of the prior art, the gas cylinder of bottled gas 35 is only required to fill the skeletal structure 32 that defines a framework around the air chamber 34 of the inflatable float safety
device 30, and not to fill the air chamber 34 itself. In this way, one small gas cylinder may be used to expand a very large float or a plurality of floats having a volume (and thus water displacement) many times larger than the volume of gas at STP that may be stored in the cylinder itself. Using gas to fill the skeleton 32 defining an air chamber 34 and not the air chamber itself overcomes many of the disadvantages of the prior art systems described hereinabove. Of particular note, in the compacted state, such a system is more compact than the typical multi-cylinder systems of the prior art, and is thus more aesthetic and practical. Furthermore, since only a small skeletal structure 32 requires inflation using bottled gas 35, and not the main chamber of the float 34, the inflation of the float is typically much faster.

Preferably the reservoir of bottled gas is permanently connected via suitable conduits 36 to the chambers of the skeletal structure 32 such that opening of a valve 37 will cause gas to be released from the reservoir of bottled gas 35 into the interconnecting air cells 33 of the skeletal structure 32. Such a valve 37 may be either manually operated, or the release of gas from the gas cylinder into the interconnecting air cells 33 of the skeletal structure 32 may be automatically actuated by a trigger device. One suitable trigger device for this automatic actuation, described by way of illustration only, includes a water level sensor that detects when the water level inside the boat exceeds a permitted maximum level. The trigger can be configured to cause the opening of an electro-valve in order to let the pressurized gas pass therethrough into the interconnecting air cells. A simple mechanical system for actuating the deployment of gas from the gas cylinder 35 into the interconnecting air cells 33 of the skeletal structure 32 is a float that might work in a manner opposite the typical functioning of a ball cock, such that the flotation of the float (indicating an inaccessible amount of water within the boat, automatically trips a valve or similar, causing gas to flow from cylinder 35 into air cells 33 of skeletal structure 32. The air chamber 34, air intake 38 and sealing means 39 of the air inflatable float safety device 30 of the third embodiment may be identical to the air chamber 24, air intake 28 and sealing means 29 of the inflatable float safety device 20 of the second embodiment, mutatis mutandis.

With specific reference now to Figure 4, in accordance with a fourth embodiment for keeping a vessel, such as a boat afloat, that eliminates the need for gas cylinders altogether, but is highly reliable, lightweight and adaptable to automatic triggering, there is shown an emergency system consisting of an air inflatable air and water impervious float safety
device 30 having a sealed, gas-fillable skeletal structure 32 that typically consists of a framework of elongated gas cells 33 (that may or may not be interconnected). The gas-fillable skeletal structure 32 of elongated gas cells 33 contains an inflating system consisting of a reactive, gas generating chemical composition 45, and a trigger means 47 for triggering the inter-reaction of the gas generating chemicals.

There are many gas-generating reactive compositions suitable for such purposes, including those developed for the so-called smokeless powders and composite type propellants used for missiles and the like. Any safe, controllable, fast chemical reaction that generates large amounts of carbon dioxide or nitrogen might be used for this purpose. Suitable decomposable or combustible compositions include the azides of alkali metals or alkaline earth metals, either used alone or with inorganic oxidizing substances such as carbonates or bicarbonates, organic thermally decomposing gas-generating substances such as azodicarbonamide and barium azodicarbonamide, azotetrazol, etc.

Suitable nitrogen generating compositions include sodium azide and manganese IV oxide, sodium azide, manganese IV oxide and zinc carbonate, sodium azide and potassium perchlorate, barium azide and potassium perchlorate or ammonium perchlorate and unsaturated polyester resin, for example.

The gas producing chemical reaction is required to be safe and reliable, and not to be prone to accidental detonation. The system incorporating such a reaction is required to include a triggering means 47. Such a triggering means might be a chemical triggering means, a mechanical triggering means or an electronic triggering means. The trigger means may be designed to be triggered automatically in response to some stimulus, such as, where the vessel is a boat, the boat beginning to sink, or water entering the hull to a certain depth for example. Alternatively, the trigger means may be designed to be triggered manually by someone on board. Particularly when the triggering means includes an electronically generated spark, the actuating stimulus may be provided in many different ways, including an acoustic actuating stimulus or a pressure actuating stimulus. The triggering means may be impact actuated, perhaps by a spring loaded actuation means.

The emergency system may include more than one trigger system, the second trigger system providing a failsafe backup. An emergency system including a plurality of trigger systems may have automatic trigger systems and manual triggers systems, so that someone
on board may be able to trigger the emergency system in rough seas, for example, with the system being triggered automatically once the vessel having the system starts to sink, or to list at an unacceptably sharp angle, for example.

For triggering a chemical reaction based, gas generating inflation system, one suitable triggering means includes an ignition device having a rotary mechanism for bringing a friction means into contact with a frictional ignition agent. One such friction means is a glass powder in a suitable bonding agent. Another frictional means is a body having a file-like rough surface. One possible frictional ignition agent is a composition including chemicals selected from the list of potassium chlorate, potassium bichromate, manganese dioxide, iron oxide, sulphur, diatomaceous earth, glass powder and zinc oxide. Indeed, there are several frictional ignition agents known, including the compositions commonly used for the heads of safety matches and the like.

With reference now to Fig. 5, in accordance with a fifth embodiment for keeping a vessel, such as a boat afloat, that again eliminates the need for gas cylinders altogether, has all the advantages of the fourth embodiment described hereinabove, but is much simpler to construct, albeit requiring very much larger quantities of gas-releasing chemicals, there is provided a directly inflatable float 50 that may be situated within a vessel, that has a gas and water impermeable skin 51 defining a sealed chamber 54 that is directly inflated by a chemical gas releasing means 55, the gas releasing reaction being triggered by a triggering means 57. In this manner, the compressed chamber 54 of the inflatable float 50 may be totally sealed with the gas releasing chemicals 55 enclosed therein. In this way, the need for a one-way valve or for sealing the float after inflation is eliminated. Suitable chemical compositions 55 and triggering means 57 for initiating the gas releasing reaction thereof may be identical to the chemical compositions 45 and triggering means 47 discussed with respect to Figure 4, mutatis mutandis.

The bottled gas 35 and the gas releasing chemical composition 45, 55 suitable for use in the third, fourth and fifth embodiments respectively, may release colourless, odourless gas, or may include small quantities of coloured and / odoured gas or coloured particles to help identify leaks and the like.

The inflatable floats may have any of a wide variety of shapes. They may be shaped and configured to expand to fit into specific voids within the particular vessel in which they
are fitted, or may have a simple utility shape such as a rectangular box like shape, a cylindrical shape or a spherical shape, for example. The rectangular shape has the highest theoretical packing density, but, in practice, cylindrical shaped floats may better accommodate each other, and other structures within a closed space. Since inflatable floats can be constructed in almost any three dimensional solid shape, and the external shape does not affect their functioning, no geometries are given herein, this being a design criterion clearly understood by the man of the art, and not an inventive feature. Likewise, although the total volume for the floats within a particular vessel required to maintain that vessel afloat can easily be calculated from Archimedes principle, and knowing whether the boat is designed for fresh water or, less dense sea water, the number and volume of individual floats for a particular vessel is a design criterion that depends on cost, safety, reliability and need, and, having now disclosed the invention, will be well understood by the man of the art.

A suitable material for use in the construction of the inflatable skin of the emergency float devices 10, 20, 30, 50 is polyethylene, but other polymeric sheet materials, or gas and water impermeable coated fabrics, such as PVC may be used. The inflatable, emergency float devices described herein may also be directly inflated using an air-pump. This is however not recommended, as such systems are labour intensive, or require a power source.

In the compacted state, the emergency float devices may be stowed behind a panel or in a locker, perhaps built into the bulwarks of the vessel. One particular feature of the present invention is that it is retrofittable to existing boats and other vessels.

**Example**

By way of example only, one embodiment of the present invention that has been prototyped is described hereinbelow with reference to Figs. 6a-6d. This exemplary embodiment is illustrative of the best enabling mode known to the inventors at the time of filing, and should in no way be construed as limiting the scope of the invention, as defined by the claims appended hereto.

Referring to Fig. 6a, there is shown, an exemplary inflatable, float safety device 60 for a vessel, in accordance with the first embodiment, shown schematically in Fig. 1. Exemplary device 60 consists of an (air and water) impervious skin 61, typically a flexible PVC skin, surrounding a skeletal structure 62. The skeletal structure 62 is able to alternatively adopt an expanded state or a contracted state, and, in the expanded state, the
skin 61 envelopes an air chamber 64. The skin 61 includes a one-way soft valve 68, that allows air to enter the air chamber 64, but not to exit therefrom, and does not require any substantial pressure gradient thereacross to function in this manner.

With reference to Fig. 6b, there is shown, in expanded configuration, the skeletal structure 62 of the exemplary device 60 of Fig. 6a in more detail. The skeletal structure 62 is made from a pair of flat steel hoops 65 having a cross-section of 1 mm x 5 mm. Each hoop, when extended, having a diameter of about 650 mm, and an essentially ovoid shape. The hoops cross at vertices 66, 67 and may be, but need not be mechanically joined together thereat, but will typically be attached to the skin 61 (Fig. 6a), thereat, by stitches covered with a welded seal, for example.

Referring now to Fig. 6c, the exemplary device 60 of Fig. 6a may be compacted into a compacted configuration 60', suitable for storage, in which the device is essentially folded down to a disc. In assuming the compacted configuration, the hoops 65 are bent into a figure of eight shape and then folded into a double loop.

When the device in the compacted configuration 60' is released, the doubled over hoops 65 are released, and assume circular shapes, and, in so doing, the air chamber 64 of the exemplary device 60 expands, sucking air through the soft valve air intake 68 (Fig. 6a) thereof.

Although the skeletal structure 62 of the exemplary device 60 (60') as shown, is constructed from two flexible hoops 65, it will be appreciated that the more hoops can be incorporated if desired, without substantially detracting from the simplicity of this exemplary embodiment.

As shown in Fig. 6d, a plurality of the exemplary devices 60 of Fig. 6a, when compacted into the storage configuration 60' shown in Fig. 6c, may be stacked into a storage sleeve 68, which is essentially a substantially cylindrically shaped sealed chamber having an access port 69, typically with a ripper mechanism via which they may be extracted from the sleeve 68 for subsequent self-expansion / inflation by virtue of the tendency for the released devices 60 to assume the expanded configuration.

Prototype devices 60, which when expanded, contain 100 liters of air, have been constructed. In the folded down, compacted state 60', these occupy a volume of a mere 0.6 liters. A storage sleeve 68 containing ten of these compacted devices 60', occupies a mere 7
liter space. No compressed gas cylinders or chemical inflation means are required, and this embodiment is practical, safe, reliable and cost-effective.

Referring now to Fig. 7, there is shown a damaged boat 70 having a plurality of expanded float devices 60 arranged within the bows 71 and stern 72 thereof. By virtue of the damage 73, to the hull 74, the boat 70 has sunk well below its plimsoll line 75. However, by virtue of the expanded float devices, the boat 70, is, nevertheless kept afloat, with its deck above the waterline 77.

Although the present invention is described and illustrated herein, with specific respect to a boat, it will be appreciated that it may be applied to other vessels, such as airplanes for example.

Furthermore, it will be appreciated that the invention is not limited to what has been described hereinabove merely by way of example. Rather, the invention is limited solely by the claims which follow.
CLAIMS

1. A safety device for keeping a vessel afloat, for use within a vessel, to prevent the sinking of said vessel; said safety device comprising an air inflatable air and water impervious float characterized by comprising a water and air impermeable skin enveloping an expandable air-chamber having an air intake.

2. The safety device of claim 1, further comprising a skeletal structure within said skin; said skeletal structure having an expanded state and a contracted state.

3. A safety device for keeping a vessel afloat as claimed in claim 2, wherein said skeletal structure is a mechanical skeletal structure that can alternately be extended to said expanded state or folded to said contracted state.

4. A safety device for keeping a vessel afloat as claimed in claim 3, wherein said mechanical skeletal structure folds and extends on a lazy-tongs principle.

5. A safety device as claimed in claim 3, wherein said mechanical skeletal structure comprises a plurality of hoops; each hoop being foldable into a figure-of-eight configuration, for compaction purposes, and releasable into an ovoid loop; said plurality of hoops, when expanded, enclosing a volume.

6. A safety device for keeping a vessel afloat as claimed in claim 1, wherein said skin is fabricated from soft PVC and said air intake includes a one-way soft valve.

7. A safety device for keeping a vessel afloat as claimed in claim 2, wherein said skeletal structure is a gas-fillable skeletal structure, and said air and water impervious float safety device additionally comprises a source of gas and a triggering device.

8. A safety device for keeping a vessel afloat as claimed in claim 7, wherein said gas-fillable skeletal structure comprises elongated air cells.

9. A safety device for keeping a vessel afloat as claimed in claim 7, wherein said source of gas includes a gas cylinder of compressed gas.
10. A safety device for keeping a vessel afloat as claimed in claim 7, wherein said source of gas includes reactive, gas generating chemicals for inflating said air and water impervious float safety device, and a trigger means for triggering the inter-reaction of said nitrogen generating chemicals.

11. A safety device for keeping a vessel afloat as claimed in claim 10, wherein said gas is nitrogen, and said gas generating chemicals include at least one of the following reactive compounds: (i) sodium azide and manganese IV oxide, (ii) sodium azide and potassium perchlorate, (iii) barium azide and potassium perchlorate, (iv) ammonium perchlorate and unsaturated polyester resin.

12. A safety device for keeping a vessel afloat as claimed in claim 10, wherein said gas generating chemicals includes zinc carbonate.

13. A safety device for keeping a vessel afloat as claimed in any of claims 10 to 12, wherein said triggering means is selected from the list of chemical triggering means, mechanical triggering means and electronic triggering means.

14. A safety device for keeping a vessel afloat as claimed in any of claims 10 to 12, wherein said triggering means includes an ignition device having a rotary mechanism for bringing a friction means into contact with a frictional igniting agent.

15. A safety device for keeping a vessel afloat as claimed in any of claims 1 to 14, where said vessel is a boat.
INTERNATIONAL SEARCH REPORT

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 B63B43/12

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED
Minimum documentation searched (classification system followed by classification symbols)
IPC 7 B63B B63C

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)
EPO-Internal, PAJ

C. DOCUMENTS CONSIDERED TO BE RELEVANT

<table>
<thead>
<tr>
<th>Category*</th>
<th>Citation of document, with indication, where appropriate, of the relevant passages</th>
<th>Relevant to claim No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>X</td>
<td>GB 2 224 979 A (MORRIS JAMES STUART) 23 May 1990 (1990-05-23)</td>
<td>1,2,7-9, 15</td>
</tr>
<tr>
<td>Y</td>
<td>the whole document</td>
<td>3-6, 10-14</td>
</tr>
<tr>
<td>Y</td>
<td>US 4 313 279 A (GREENBAUM GEORGE) 2 February 1982 (1982-02-02) abstract; figures</td>
<td>3</td>
</tr>
<tr>
<td>Y</td>
<td>US 5 800 067 A (EASTER SCOTT D) 1 September 1998 (1998-09-01) column 3, line 4 -column 4, line 52; figures</td>
<td>3</td>
</tr>
</tbody>
</table>

Further documents are listed in the continuation of box C.

Patent family members are listed in annex.

* Special categories of cited documents:
**A** document defining the general state of the art which is not considered to be of particular relevance
**E** earlier document but published on or after the international filing date
**L** document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
**C** document referring to an oral disclosure, use, exhibition or other means
**P** document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.
"A" document member of the same patent family

Date of the actual completion of the international search
23 September 2003

Date of mailing of the international search report
06/10/2003

Name and mailing address of the ISA
European Patent Office, P.B. 5818 Patentlaan 2
NL - 2280 HV Rijswijk,
Tel. (+31-70) 340-5400, Tx. 31 651 epc nl,
Fax (+31-70) 340-3016

Authorized officer
Moya, E

Form PCT/ISA/210 (second sheet) (July 1992)
<table>
<thead>
<tr>
<th>Category</th>
<th>Citation of document, with indication, where appropriate, of the relevant passages</th>
<th>Relevant to claim No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Y</td>
<td>US 6 080 027 A (RODEMANN WILL) 27 June 2000 (2000-06-27) column 4, line 47 - line 57; figures</td>
<td>6</td>
</tr>
<tr>
<td>A</td>
<td>WO 00 69718 A (TRITECH TECHNOLOGY PTY LTD; WIGGINS RENARD JONAS (AU)) 23 November 2000 (2000-11-23) abstract; figures</td>
<td>7-9</td>
</tr>
<tr>
<td>Y</td>
<td>JP 09 132494 A (TOKAI Rika Co Ltd) 20 May 1997 (1997-05-20) the whole document</td>
<td>10,11, 13,14</td>
</tr>
<tr>
<td>Y</td>
<td>US 4 929 214 A (LIEBERMANN RON B) 29 May 1990 (1990-05-29) column 2, line 45 - column 4, line 50; figures</td>
<td>10,11, 13,14</td>
</tr>
<tr>
<td>Y</td>
<td>US 3 639 183 A (CRESCECNO FRANK G ET AL) 1 February 1972 (1972-02-01) column 3, line 73 - column 4, line 5</td>
<td>12</td>
</tr>
</tbody>
</table>
## INTERNATIONAL SEARCH REPORT

**Information on patent family members**

<table>
<thead>
<tr>
<th>Patent document cited in search report</th>
<th>Publication date</th>
<th>Patent family member(s)</th>
<th>Publication date</th>
</tr>
</thead>
<tbody>
<tr>
<td>GB 2224979</td>
<td>23-05-1990</td>
<td>NONE</td>
<td></td>
</tr>
<tr>
<td>US 4313279</td>
<td>02-02-1982</td>
<td>NONE</td>
<td></td>
</tr>
<tr>
<td>US 5800067</td>
<td>01-09-1998</td>
<td>NONE</td>
<td></td>
</tr>
<tr>
<td>US 4032086</td>
<td>28-06-1977</td>
<td>NONE</td>
<td></td>
</tr>
<tr>
<td>US 4844109</td>
<td>04-07-1989</td>
<td>NONE</td>
<td></td>
</tr>
<tr>
<td>US 6080027</td>
<td>27-06-2000</td>
<td>NONE</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>AU 4524300 A</td>
<td>05-12-2000</td>
</tr>
<tr>
<td></td>
<td></td>
<td>BR 0010561 A</td>
<td>21-05-2002</td>
</tr>
<tr>
<td></td>
<td></td>
<td>CA 2373369 A1</td>
<td>23-11-2000</td>
</tr>
<tr>
<td></td>
<td></td>
<td>CN 1356947 T</td>
<td>03-07-2002</td>
</tr>
<tr>
<td></td>
<td></td>
<td>EP 1192076 A1</td>
<td>03-04-2002</td>
</tr>
<tr>
<td></td>
<td></td>
<td>JP 2002544062 T</td>
<td>24-12-2002</td>
</tr>
<tr>
<td></td>
<td></td>
<td>NO 20015574 A</td>
<td>08-01-2002</td>
</tr>
<tr>
<td></td>
<td></td>
<td>NZ 516168 A</td>
<td>28-03-2003</td>
</tr>
<tr>
<td></td>
<td></td>
<td>TR 200103564 T2</td>
<td>21-05-2002</td>
</tr>
<tr>
<td></td>
<td></td>
<td>TW 499381 B</td>
<td>21-08-2002</td>
</tr>
<tr>
<td></td>
<td></td>
<td>ZA 200110255 A</td>
<td>25-06-2002</td>
</tr>
<tr>
<td>JP 09132494</td>
<td>20-05-1997</td>
<td>NONE</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>GB 2240077 A</td>
<td>24-07-1991</td>
</tr>
<tr>
<td>US 3639183</td>
<td>01-02-1972</td>
<td>NONE</td>
<td></td>
</tr>
</tbody>
</table>