



A BUOYANCY AID

The present invention relates to a buoyancy aid for an amphibious vehicle and in particular though not solely for use on vehicles such as a military vehicle that are adapted to move through a body of water.

BACKGROUND OF INVENTION

In operation, it is not uncommon for armoured vehicles needing to cross water in their field of operation. By their nature armoured vehicles are very compact and heavy. Therefore if such vehicles were not equipped with some sort of buoyancy aid or flotation device such vehicles could sink in the body of water.

Armoured vehicles that do float without any aid require the vehicles to be of a sufficiently large enclosed volume or to be made of a very light weight material. This however, may be at the expense of the vehicles load carrying capacity and impact resistance. Such vehicles also have a relatively low free board and subsequently a limited safety margin. Thus at times if there is any uneven distribution of weight in the vehicle, the vehicle can experience uneven trim and heel during floatation which in turn can increase the chances of the vehicle tipping or sinking. The safety margin is hence less. It is envisaged that in times of harsh operating conditions, or where there is much urgency and turmoil in the surroundings, the safety margin may be reduced even further.

In US Patent 5,113,779 a floating device for a combat vehicle has been utilised to enable a combat vehicle to float in a body of water. A pump is used to inflate the device that is protected by an armoured plate from above the waterline. Patent 5,113,799 is also to vary the trim and heel by sizing the bag accordingly.

It is recognised that there is an advantage in having a buoyancy aid attached to an amphibious vehicle that can provide the additional buoyancy force required and can vary the trim and heel conditions of the amphibious vehicle thereby increasing the safety margin during the swimming operation.

Furthermore deployment of the bag of US 5,113,779 is achieved by compressed air being delivered into the bag. To provide compressed air to the bag further adds to the equipment that needs to be carried by the vehicle to achieve such deployment. It is therefore desirable to have a device which is able to self inflate and be deployed without the aid of a pump or equivalent.

It is therefore an object of the present invention to provide an buoyancy aid that can be used for an amphibious vehicle which addresses the above mentioned advantages and avoids the above mentioned disadvantages or which will at least provide the potential uses of such a device with a useful choice.

BRIEF DESCRIPTION OF THE PRESENT INVENTION

In a first aspect the present invention is a buoyancy aid for an amphibious vehicle adapted to travel in water, comprising or including,

a flexible bag variable in volume to engage at a first region thereof to a perimeter portion of said vehicle

a flexible bag displacement means including (i) a rigid cover member and (ii) a means to support said rigid cover member from said vehicle in a manner to be movable from said vehicle between an extended position and a stored position more proximate to said vehicle than said extended position, said rigid cover movable between said extended position and a stored position in a direction perpendicular to the vertical

wherein a second region of said flexible bag is correspondingly and dependently movable with said flexible bag displacement means towards and away from said vehicle to thereby vary the volume of said flexible bag between an reduced volume condition and more inflated volume condition respectively

said flexible bag including at least one air opening which as said second region is moved towards or away from said vehicle allows ambient air to be displaced therethrough

said flexible bag to be positioned relative to said vehicle to become at least partially submerged in said water and such that said at least one opening becomes sealed to ambient air by said water thereby sealing a quantity of air inside said flexible bag.

Preferably said second region is engaged to said rigid cover member.

Preferably said flexible bag comprises a base wall and an upper wall, an inward side wall and an outward side wall extending between said base and upper walls, a front end wall and a rear end wall extending between said base and upper walls and extending between front and rear edges of the inward side wall and outward sidewall, said inward side wall to be juxtaposed to said vehicle, said inward side wall including said first region and said outward side wall including said second region.

Preferably flexible baffles are positioned within said flexible bag and extend between said inward side wall and said outward sidewall.

Preferably said flexible baffles create separate compartments within said flexible bag, each compartment provided with a said at least one opening.

Preferably said flexible bag is to be engaged to the sides of an amphibious vehicle and is of a height where part of said flexible bag is to become submerged yet presenting at least some portion of said flexible bag when in said more inflated volume condition, above the level of said water.

Preferably said rigid cover member is juxtaposed to said outward side wall of said flexible bag.

Preferably said rigid cover member extends the length (end wall to end wall) of said flexible bag.

Preferably said rigid cover member extends the height (upper wall to lower wall) of said flexible bag.

Preferably said at least one air opening is provided at the lower wall of said flexible bag.

5 Preferably said at least one air opening is provided through a wall of said flexible bag and a conduit is provided to extend outwardly of said bag from said opening.

Preferably said at least one air opening is provided through a wall of said flexible bag and a conduit is provided to extend outwardly of said bag from said opening and locates an opening at below said flexible bag.

10 Preferably said conduit is a flexible conduit.

Preferably said conduit is resiliently flexible.

Preferably said conduit presents a mouth opening at the end distal from the end engaged with said air opening which is (when said vehicle is in a horizontal position) lower than the lower region of said flexible bag, when in said expanded condition.

15 Preferably said means to support includes are at least two arms movably mounted from said vehicle.

Preferably at least two pairs of arms are provided each pair of arms configured to define a scissor mechanism.

20 Preferably said scissor mechanism comprises two arms, each pair pivotally engaged to each other intermediate of their distal ends and engaged to engage to said vehicle each at a first distal end thereof and engaged to said rigid cover member at the other distal end thereof.

25 Preferably said means to move includes a plurality of linkage arms extending from an elongate control member to engage there with and extend to said rigid cover and said vehicle in a four-bar-chain arrangement.

Preferably a plurality of first side legs are spaced along and pivotally engaged to and extending between said elongate control member and said vehicle.

30 Preferably said plurality of second side legs are spaced along and/or pivotally engaged to and extending between said elongate control member and said rigid cover, wherein displacement of said elongate control member in a direction parallel to its general elongate direction will displace said rigid cover member towards or away from said vehicle.

Preferably each first side leg extends from said elongate control member at the same point as a said second side leg.

35 Preferably an actuation means is used to move said flexible bag displacement means.

Preferably each said at least two arms are (a) to be pivotably mounted to said vehicle a respective about vertical pivot axis which are spaced from each other and (b)

pivotably engaged to said rigid cover member at a distance along arms spaced from said vertical pivot axis.

Preferably the relationship between said at least two arms is parallel.

Preferably said rigid cover member is of an armoured plated material.

5 In another preferred form of the invention the buoyancy aid can be fitted to other forms of vehicle or made to fit different sized vehicles depending on the use of the vehicle.

In another preferred form of the present invention the invention consists in the retro-fitting of a buoyancy aid to provide flotation to a vehicle whether armoured or not.

10 In yet a further aspect the present invention consists in a buoyancy aid as herein described with reference to any one or more of the accompanying representations.

This invention may also be said to broadly consist in the part, elements and features referred to or indicated in the specification of the application, individually or collectively, and any or all combinations of any two or more of said parts, elements or features, and where specific integers are mentioned herein that have known equivalents in the art to
15 which this invention relates, such known equivalents are deemed to be incorporated herein as individually set forth.

BRIEF DESCRIPTION OF DRAWINGS

20 The invention consists in the foregoing and also envisages constructions of which the following gives examples.

One preferred form of the present invention will now be described with reference to the accompanying drawings in which:

Figure 1 is a perspective view of the buoyancy aid incorporating a scissor mechanism, for displacing the rigid cover to and from the vehicle,

25 **Figure 2** is a close up view of region A of Figure 1 showing the flexible bag in a partially collapsed state,

Figure 3 is a top view of Figure 1,

Figure 4 is a side view of the present invention with the rigid cover removed to show the flexible baffles forming the separate compartments of the flexible bag,

30 **Figure 5A** is a front view of the invention where the buoyancy aid is in a retracted position,

Figure 5B is a front view of the present invention where the buoyancy aid is in its extended position,

35 **Figure 6** is a front view of the present invention and where the amphibious vehicle is shown on an incline,

Figure 6A shows a flexible bag with a conduit and without a conduit,

Figure 7 is a close up view of the scissor mechanism,

Figure 8 is a perspective view of the present invention where the linkage mechanism includes at least one scissor mechanism as well as the linkage arms for movement of the rigid cover,

Figure 9 is a top view of part of the vehicle showing the linkage mechanisms including the scissor mechanism and the linkage arm arrangement,

Figure 10 is a perspective view of an alternative arrangement of flexible bags and associated mechanism, and

Figure 11 is a plan view of Figure 10.

DETAILED DESCRIPTION OF THE INVENTION

In one of the preferred forms of the present invention as shown in Figure 1 a buoyancy aid 1 is attached to a vehicle 4. The buoyancy aid includes a flexible bag 2 disposed between a rigid cover 3 and the vehicle 4. One of the main purposes of the rigid cover is to provide impact protection for the flexible bag 2. It can be seen in for example Figure 6, that the rigid cover extends above and below the flexible bag so that it is difficult for projectiles to puncture the bag unless the projectiles approach from above or end on of the vehicle or ricochet around the vehicle and puncture the bag.

The rigid cover is displaceably carried by and relative to the vehicle. This is achieved by for example a movable support means which provides support to the cover from the vehicle. The support means may for example be a linkage mechanism extending between the vehicle and the rigid cover. The cover, by the linkage mechanism is able to move between conditions extended from the vehicle and retracted towards the vehicle.

In the most preferred form where the buoyancy aid of the present invention is provided to the side of a vehicle (to thereby provide buoyancy aid to the vehicle in that the bag is located to extend partially into the water and extend above the water when the vehicle is in the water) the rigid cover preferably extends in a general vertical plane. However this need not be so and the cover may be planar and extend at an incline to the vertical.

In addition, or alternatively, the buoyancy aid of the present invention may be provided to the front and rear of the vehicle, however in the most preferred form the buoyancy aid is provided to each side of the vehicle and extends substantially longitudinally with the vehicle (in the forward/rearward directions). As can be seen for example in Figure 1, the rigid cover may extend substantially the entire length and height of the side of the vehicle. The buoyancy aid is retained between the rigid cover and the vehicle and may be co-extensive with the rigid cover or can be of a smaller size to the rigid cover.

The flexible bag may in general be of a square or rectangular cross section when viewed through a cross section lateral to the longitudinal direction of the vehicle and is defined by an upper region 9, a base region 14, side walls 41 and 42, (41 being

immediately adjacent to the vehicle and 42 being adjacent to the rigid cover), and end walls 10 and 11.

The flexible bag is comprised of a series of compartments 8 that are separated by baffles joined together at the join lines 7 indicated in Figure 1. Preferably no air transfer can occur between compartments. Having a series of compartments ensures that when there is battle fire, then if any of the compartments are damaged, ie. hit with a bullet, the buoyancy aid is still able to provide floatation to the vehicle notwithstanding that some of the compartments are damaged. Thus the vehicle can afford to lose a few of the compartments 8 and yet retain sufficient buoyancy to remain afloat.

Figure 3 more clearly shows the flexible bag including a series of baffles defining compartments within the bag.

The linkage mechanism 5 preferably is or includes a scissor mechanism 6 located at the forward and rear end of the flexible bag and is disposed to operate between the rigid cover and the vehicle. The scissor mechanism is at a sufficient distance "X" from the bag to ensure there is clearance from the flexible bag to prevent the scissor mechanism interfering with the flexible bag in its extended state thereby reducing wear and tear. The linkage mechanism aids in or causes the extension and collapsing of the flexible bag. In the extended position the scissor mechanism holds the rigid cover so the bag is in an inflated state and provides support to the flexible bag and the cover in this state. The movement of the rigid cover relative to the vehicle is substantially in a horizontal direction. Indeed it is preferred that the movement of the rigid cover is also substantially parallel to the sides of the vehicle. With the movement being horizontal, no additional lifting force is required to be applied to the buoyancy aid other than the supporting force which is necessary to carry the weight of the rigid cover (and the weight of components dependent therefrom) and which is provided by the linkage mechanism. Hence minimal force is required to deploy the buoyancy aid.

Figure 4 shows another preferred form of the present invention where the rigid cover has been removed.

The flexible bag and preferably each compartment of the flexible bag is provided with an air opening 13. The air opening 13 allows air to be drawn into and to be expelled from the enclosed volume of the flexible bag. In moving between the extended and retracted position of the rigid cover the side wall 42 of the bag is also displaced relative to the vehicle. The side wall 41 remains stationary relative to the vehicle and as a result of the displacement, the volume of the flexible bag is varied.

The air opening 13 is located at the base 14 of each compartment 8. A conduit 15 may be provided to extend from the opening and below the base 14 of each compartment.

The air opening 13 thereby allows for air to enter into and to be expelled from the bag upon the movement of the rigid cover towards and away from the vehicle.

Prior to entering the water, a user, (whether remotely or directly) may move the linkage mechanism to displace the rigid covers to the extended position to thereby draw air through the opening(s) into the then expanding flexible bag. Once the vehicle has entered the water, the opening will be placed below the water line.

5 The opening being below the water line is sealed by the water to prevent the trapped air escaping. The pressure of the trapped air 17 will increase as the vehicle further enters the water because of external water pressure acting on the volume inside. Water will partially flood into the compartments (since the air inside is compressable), until the hydrostatic pressure of the water equalises with the air pressure in the bag. As the water
10 level rises in the flexible bag, the water pressure being exerted by the water will eventually equal the internal air pressure within each flexible baffle. The water level will then remain at this equilibrium pressure unless for example the vehicle loading is changed, or an explosive detonates on one side of the vehicle causing more external pressure on one side of the vehicle than the other, forcing the vehicle to dip and exert more pressure onto
15 the side from where the explosive detonated.

It can be envisaged that as each flexible bag provides a buoyancy to the vehicle, it can also vary the trim of the vehicle while in water. This may be achieved by varying the size of the compartments within the flexible bag to create a balancing force that can be used to adjust the trim of the vehicle.

20 The provision of the opening 18 at the end of a conduit 15 is desirable but not essential. With reference to Figure 6A, it can be seen that as the vehicle on the left hand side (without such a conduit) enters the water on a slope, the angle of the opening 13 is such that the opening will remain exposed to the external air whilst a waterline can be established through the opening. This would allow ingress of water into a compartment.

25 With reference to the right hand vehicle of Figure 6A, the opening 13 has extending therefrom a conduit 15 which itself has an opening positioned below the base 14 of the compartment. The opening of the conduit 15 will itself be sealed to the outside air at a point prior to the waterline being able to be established to extend through the opening 13 of the compartment. Accordingly as soon as the opening of the conduit 15 is sealed by the
30 water the displacement from the compartment of compartment contained air by ingressing water will be prevented.

It may indeed be a variation to the present invention that the opening 13 to the compartment is placed at a region higher than the bottom of the compartment (even above the waterline) but is engaged to a conduit which provides the inlet thereof to be positioned
35 below the water line.

Figure 7 illustrates the scissor mechanism having a pair of arms 19 and 50. The lower end of arm 19 is pivotably fixed to the vehicle 20 and the corresponding end is slidably attached to the vehicle at 51. The other arm of the pair 50 is pivotably fixed to the rigid cover at 52 and the corresponding upper end is slidably attached to the vehicle at 53.

The pair of arms 19 and 50 are pivotably fixed at their crossing point 54. The sliders 21 and 55 allows the scissor mechanism to move in substantially one plane of direction, preferably to allow the displacing of the rigid cover to and from the vehicle.

Figure 8 shows another preferred form of the present invention where the linkage mechanism includes a scissor mechanism and a linkage means 23 in a four-bar-chain or parallelogram arrangement. The linkage means provides further support along the upper region of the flexible bag and to the scissor mechanism in holding the flexible bag in the extended positions.

The linkage means 23 as in Figure 9 has an elongate member 25 which extends substantially parallel to the vehicle in the forward/rearward direction and extends intermediate of the vehicle 4 and the rigid cover 3. Pivotally extending from the elongate control member at intervals there are first side legs 28 and second side legs 24. The first side legs extend between the elongate member and the vehicle in a pivotal relationship and the second side legs extend between the rigid cover and the elongate member also in a pivotable relationship. An actuator 27 may be disposed to act on the elongate member to move the elongate member in the longitudinal direction to thereby cause the displacement of the rigid cover towards and away from the vehicle as required.

With reference to Figure 10, there is shown an alternative arrangement of the present invention. In this arrangement and also with reference to Figure 11, swing arms 64 are pivotably dependent from the sides of a vehicle in a manner to allow them to pivot about a substantially vertical axis. The arms 64 are also pivotably engaged to the rigid cover about a vertical axis. Pivoting of the arms 64 relative to the vehicle about a horizontal axis is prevented and hence the arms are able to provide a vertical supporting force to the cover. In moving between a collapse and extended position, the arms and the cover move in a parallelogram manner. With reference to for example Figure 11 the arms can move from a position which is substantially parallel to the sides of the vehicle and to the substantially planar direction of the cover (when the bag is in a collapsed condition) to a position where the arms extend away from the vehicle. The pivoting movement of the arms will simultaneously displace the cover away from the sides of the vehicle (preferably remaining parallel to the sides of the vehicle) thereby moving the bag to an extended position. The parallel movement of the arms may however not be essential.

The present invention can be modified to fit many types of vehicle independent of size or use including for example a jeep where the buoyancy aid is more likely to be located at the rear and front of a vehicle rather than the sides.

The present invention can also be retro-fitted to provide flotation to a vehicle whether armoured or not.

CLAIMS:

1. A buoyancy aid for an amphibious vehicle adapted to travel in water, comprising or including,

a flexible bag variable in volume to engage at a first region thereof to a perimeter portion of said vehicle

a flexible bag displacement means including (i) a rigid cover member and (ii) a means to support said rigid cover member from said vehicle in a manner to be movable from said vehicle between an extended position and a stored position more proximate to said vehicle than said extended position, said rigid cover movable between said extended position and a stored position in a direction perpendicular to the vertical

wherein a second region of said flexible bag is correspondingly and dependently movable with said flexible bag displacement means towards and away from said vehicle to thereby vary the volume of said flexible bag between an reduced volume condition and more inflated volume condition respectively

said flexible bag including at least one air opening which as said second region is moved towards or away from said vehicle allows ambient air to be displaced therethrough

said flexible bag to be positioned relative to said vehicle to become at least partially submerged in said water and such that said at least one opening becomes sealed to ambient air by said water thereby sealing a quantity of air inside said flexible bag.

2. A buoyancy aid as claimed in claim 1 wherein said second region is engaged to said rigid cover member.

3. A buoyancy aid as claimed in claims 1 or 2 wherein said flexible bag comprises a base wall and an upper wall, an inward side wall and an outward side wall extending between said base and upper walls, a front end wall and a rear end wall extending between said base and upper walls and extending between front and rear edges of the inward side wall and outward sidewall, said inward side wall to be juxtaposed to said vehicle, said inward side wall including said first region and said outward side wall including said second region.

4. A buoyancy aid as claimed in any one of claims 1 to 3 wherein flexible baffles are positioned within said flexible bag and extend between said inward side wall and said outward sidewall.

5. A buoyancy aid as claimed in claim 4 wherein said flexible baffles create separate compartments within said flexible bag, each compartment provided with a said at least one opening.

6. A buoyancy aid as claimed in claims 1 to 5 wherein said flexible bag is to be engaged to the sides of an amphibious vehicle and is of a height where part of said flexible bag is to become submerged yet presenting at least some portion of said flexible bag when in said more inflated volume condition, above the level of said water.

7. A buoyancy aid as claimed in any one of claims 3 to 6 wherein said rigid cover member is juxtaposed to said outward side wall of said flexible bag.

8. A buoyancy aid as claimed in claim 7 wherein said rigid cover member extends the length (end wall to end wall) of said flexible bag.

9. A buoyancy aid as claimed in claims 7 or 8 wherein said rigid cover member extends the height (upper wall to lower wall) of said flexible bag.

10. A buoyancy aid as claimed in any one of the claims 3 to 9 wherein said at least one air opening is provided at the lower wall of said flexible bag.

11. A buoyancy aid as claimed in any one of claims 1 to 10 wherein said at least one air opening is provided through a wall of said flexible bag and a conduit is provided to extend outwardly of said bag from said opening.

12. A buoyancy aid as claimed in any one of claims 1 to 11 wherein said at least one air opening is provided through a wall of said flexible bag and a conduit is provided to extend outwardly of said bag from said opening and locates an opening at below said flexible bag.

13. A buoyancy aid as claimed in claims 11 or 12 wherein said conduit is a flexible conduit.

14. A buoyancy aid as claimed in any one of claims 11 to 13 wherein said conduit is resiliently flexible.

15. A buoyancy aid as claimed in any one of claims 11 to 14 wherein said conduit presents a mouth opening at the end distal from the end engaged with said air opening which is (when said vehicle is in a horizontal position) lower than the lower region of said flexible bag, when in said expanded condition.

16. A buoyancy aid as claimed in any one of the preceding claims wherein said means to support includes at least two arms movably mounted from said vehicle.

17. A buoyancy aid as claimed in claim 16 wherein at least two pairs of arms are provided each pair of arms configured to define a scissor mechanism.

18. A buoyancy aid as claimed in claim 17 wherein said scissor mechanism comprises two arms, each pair pivotally engaged to each other intermediate of their distal ends and engaged to engage to said vehicle each at a first distal end thereof and engaged to said rigid cover member at the other distal end thereof.

19. A buoyancy aid as claimed in any one of the preceding claims wherein said means to move includes a plurality of linkage arms extending from an elongate control member to engage there with and extend to said rigid cover and said vehicle in a four-bar-chain arrangement.

20. A buoyancy aid as claimed in claim 19 wherein a plurality of first side legs are spaced along and pivotally engaged to and extending between said elongate control member and said vehicle.

21. A buoyancy aid as claimed in claim 20 wherein said plurality of second side legs are spaced along and/or pivotally engaged to and extending between said elongate control member and said rigid cover,

wherein displacement of said elongate control member in a direction parallel to its general elongate direction will displace said rigid cover member towards or away from said vehicle.

22. A buoyancy aid as claimed in any one of claims 20 or 21 wherein each first side leg extends from said elongate control member at the same point as a said second side leg.

23. A buoyancy aid as claimed in any one of the preceding claim wherein an actuation means is used to move said flexible bag displacement means.

24. A buoyancy aid as claimed in claim 16 wherein each said at least two arms are (a) to be pivotably mounted to said vehicle a respective about vertical pivot axis which are spaced from each other and (b) pivotably engaged to said rigid cover member at a distance along arms spaced from said vertical pivot axis.

25. A buoyancy aid as claimed in claim 24 wherein the relationship between said at least two arms is parallel.

26. A buoyancy aid as claimed in any one of the preceding claims wherein said rigid cover member is of an armoured plated material.

27. A buoyancy aid as herein described with reference to any one or more of the accompanying representations.

28. An amphibious vehicle including a buoyancy aid as claimed in any one of the preceding claims.

29. An amphibious vehicle including a buoyancy aid as claimed in any one of the preceding claims engaged to each side of said vehicle.

30. A buoyancy aid as claimed in any one of the claims 1 to 26 which is retrofittable to an amphibious vehicle.