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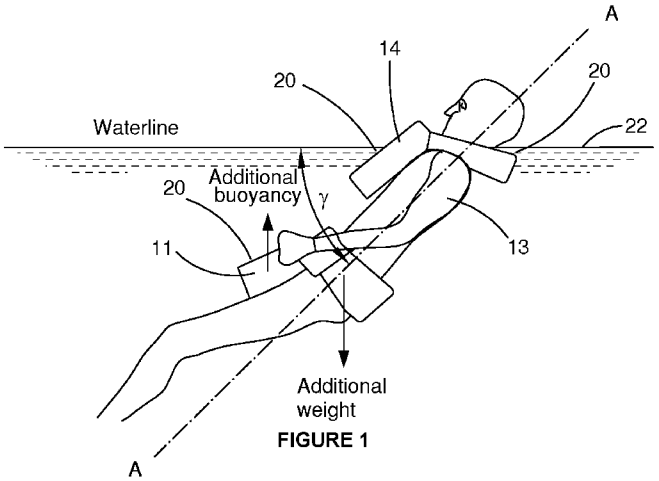

FIGURE 1

(57) Abstract: The present invention relates to a floatation device for encumbered people carrying equipment such as military personnel and offshore workers. Ideally, the floatation device includes an auxiliary floatation device for encumbered users that can be used with a primary lifejacket worn by a user. The auxiliary floatation device includes a buoyancy portion that, in 5 use, can be attached to the legs of the user, and the orientation of the torso of the user is controlled by the buoyancy force provided by the buoyancy portion and, in turn, effect the distance between the mouth of a user and waterline, which is referred to as the "freeboard".

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TITLE: AN AUXILLARY FLOATATION DEVICE AND A FLOATATION DEVICE

FIELD OF THE INVENTION

The present invention relates to an auxiliary floatation device that can be worn with a primary lifejacket, and a floatation device. A floatation device of some form is required when a user is forced into the water in an emergency situation to reduce the likelihood of drowning.

BACKGROUND OF THE INVENTION

By way of example navy, army and air force personnel are sometimes required to enter water carrying packs and other equipment including body armour, ammunition, helmets and so forth that add considerable weight. Some military personnel can be encumbered, for example, by an additional weight in the order of 10 to 30 kilograms.

Many life vests and lifejackets presently in use are not designed for encumbered users and provide inadequate floatation. Other design flaws include crotch straps that are uncomfortable for encumbered users, leading to users not wearing the lifejacket tightly on their body, which reduces the effectiveness of the lifejacket.

Some improvements that have been made to standard lifejackets including, for example, the devices are more comfortable to enable the device to be worn tightly on the body of the user. Dry-suits that enclose the user have also been developed which provide all over body support and prevent hyperthermia. However, some of the disadvantages of a dry-suit include restricted body movement making it difficult to swim, unwanted air pockets affecting lifejacket performance and the suit can be time consuming to put on making them inappropriate in emergency situations.

SUMMARY OF THE INVENTION

The survival of an encumbered user relies, in part, on maintaining a good distance between the mouth of the user and a waterline. The distance between the mouth of the user and the waterline, is hereinafter referred to as the "freeboard".

The present invention relates to an auxiliary floatation device that can be used with a primary lifejacket worn by an encumbered user, wherein the auxiliary floatation device includes a buoyancy portion that, in use, can be attached to the legs of the user, and the orientation of the torso of the user is controlled by the buoyancy force provided by the buoyancy portion and, in turn, effect the freeboard.

Controlling the orientation of the torso of the user using the auxiliary device can increase the freeboard compared to when no auxiliary floatation device is used, or in other words, when only the primary lifejacket is used.

The orientation of the torso of the user in the water is a function of a number of parameters, including the weight by which the user is encumbered, the body type, weight distribution and centre of mass of the user and the encumbered weight, and the location and magnitude of the buoyancy force acting on the user when in the water.

The buoyancy force of the auxiliary floatation device is the result of the device being fully submerged. As a result, the auxiliary floatation device is located further away from the user's mouth than a buoyancy force of the primary lifejacket. In other words, the buoyancy force of the auxiliary device can have a large "lever" effect because of its position relative to the mouth of the user, which we have found can be more useful in controlling the orientation of the torso of the user in the water.

Ideally the buoyancy force of the auxiliary floatation device controls the orientation of the torso of the user to automatically orientate into a reclined or supine position in the water. In this position the user's back is directed downward and the face of the user is directed upward. Moreover, we have found that the user can be held in a more stable position in a supine position using the auxiliary floatation device, thereby increasing the chance of survival of the user.

Ideally, the longitudinal axis of the torso of the user is in the range of 30 to 60 degrees to the horizontal. This range is measured in a forward direction of the user.

It is possible that the buoyancy portion may have a single buoyancy element only. For example, the single buoyancy element may extend across the buttock or pelvic region of the user and is attached to the user via a harness that includes leg straps that extend about each leg of the user.

However, preferably the buoyancy portion includes two buoyancy elements that are each attached to the thighs of the user.

The buoyancy elements may be attached to the front of at least one leg, and ideally both legs of the user to orient the user into a reclined or supine position.

The auxiliary floatation device may include thigh straps that extend about the thighs of the user. The thigh straps may be removably or non-removably connected to the buoyancy portion of the auxiliary device using a quick attachment and release system. Preferably, the thigh straps extend about the thighs of the user below the user's buttock. The thigh straps may have quick release fasteners such as buckles for quick donning and doffing of the auxiliary device.

The auxiliary floatation device may include a harness including a waist strap that extends about the waist of the user and two legs straps extending from the waist strap that extends about the legs of the user. The waist straps and the leg straps may be adjustable. Preferably,

the leg straps extend about the thighs of the user below the user's buttock. Ideally, the harness can also be attached to the primary lifejacket.

When the auxiliary device is used in combination with a primary lifejacket, the thigh straps or the legs straps allow the crotch straps of some conventional the primary lifejackets to be omitted. In other words, a purpose of the thigh strap or the legs straps, in addition to securing the auxiliary flotation device, is to replace the crotch strap(s) of the primary lifejacket which can place a high point load onto the user's groin area by the heavy equipment worn. The thigh straps or legs straps can remove a point load, by evenly distributing the load onto the user's thighs.

The buoyancy portion may provide a buoyancy force up to 100N and suitably in the range of 10 to 100N. Even more suitably, the buoyancy force may be in the range of 30 to 80N, and even more suitably in the range of 40 to 70N.

The buoyancy portion may include at least one inflatable bladder, and suitably may include two inflatable bladders, one for each leg of the user.

The auxiliary device may include at least one openable housing for containing at least one of the inflatable bladders in a compact configuration for storage while deflated. When the bladder is deflated, little or no buoyancy force is provided. Ideally, the auxiliary device includes two openable housings, one of the housings from each bladder.

The or each housing is ideally attached to the thigh straps.

The or each housing may be any size and is suitably sized to compactly contain the or each bladder in a deflated condition so that the auxiliary floatation device does not to interfere with normal military operations. The or each housing may have a length in the range of 10 to 15cm, a width in the range of 8 to 12cm and height in the range of 5 to 10 cm.

The auxiliary floatation device may also include an oral inflation assembly that is arranged so that a user wearing the auxiliary device can inflate the or each bladder by blowing from their mouth. The oral inflation assembly may include a hose and a one way valve that allows a person to blow into the hose to inflate the or each bladder.

Suitably, the user can adjust the buoyancy force of the auxiliary floatation device by changing the degree to which the bladder(s) are inflated, and in turn, control the orientation of the torso of the user and improve the mouth freeboard. For instance, by increasing the buoyancy force the user can adjust their orientation into a more reclined position. The user can increase the buoyancy force by increasing the degree of inflation of the bladder(s).

Conversely, by reducing the buoyancy force the user can adjust their orientation into a more upright position.

The buoyancy portion may also have a vent, such as a screw valve that the user can open and close to reduce the degree to which the bladder(s) is inflated.

An advantage of using one or more bladders in the buoyancy portion is that the user can adjust the buoyancy force, and in turn, control the orientation of their torso and freeboard while in the water.

The hose may be self-retracting, for example, the hose may be arranged in a coil formation, that can be pulled into an extended form and auto-retract into a coiled formation. The coiled formation may be a spiral.

In another embodiment, the coiled formation may be wound about a drum and the drum is biased to wind the hose onto the drum.

The auxiliary floatation device may include a pressurised gas cylinder that is arranged to inflate the or each bladder. Suitably, a user can control the degree to which the or each bladder is inflated by controlling gas flow from the cylinder into the or each bladder and, in turn, enable the buoyancy force of the lower buoyancy to be adjusted to control the orientation of the torso of the user. Controlling the gas flow into the bladders may include an ON/OFF valve with a slow release bleed valve to control the flow of gas from cylinder into the bladders.

In an embodiment, the oral inflation assembly may be provided in combination with the gas cylinder for inflation.

The bladders may be interconnected by a flow passageway to allow the passage of gas from one bladder into the other. The advantage provided by this arrangement is that the oral inflation assembly and/or gas cylinder may be flow connected to one of the bladders only and inflation of one of the bladder allows inflation of the other bladder via the passageway.

The buoyancy portion may include one or more foam elements, for example including closed cell foam elements. In the situation which the lower buoyancy comprises a single foam element, the orientation of the torso of the user may be controlled by adjusting the position of the lower buoyancy on the legs of the user.

In the situation in which the buoyancy portion includes multiple foam elements, the orientation of the torso of the user may be controlled by the number of the foam elements included in the buoyancy portion. For example, the orientation of the torso of the user may be controlled by changing the number of the foam elements contained in the buoyancy portion. In this instance, the auxiliary device may include one or more openable pockets that receive the foam elements. The foam elements may also be provided in a range of sizes, and the orientation of the torso of the user may be controlled by adjusting the buoyancy force of the buoyancy portion by substituting foam elements with foam elements of different sizes, or increasing or reducing the number of foam elements in the buoyancy portion.

The present invention also relates to a floatation device for encumbered users including:

a harness having a waist strap that extends about the waist of a user and at least one thigh strap that extends about a leg of a user below the buttock of the user;

an upper abdominal buoyancy portion that is attached to the waist strap of the harness; and

a lower buoyancy portion that is attachable to the thigh strap;

wherein the orientation of the body of the user in the water is able to be controlled by the buoyancy force provided by the lower buoyancy portion and, in turn, effect the freeboard.

The lower buoyancy portion may include any one or a combination of the features of the auxiliary floatation device described herein.

The upper abdominal buoyancy portion may be a yoke lifejacket or a bib lifejacket. Yoke lifejackets are known to have a U- shape in which the lobes of the U-shape are locate on the front of the abdomen of a user. In contrast, bib lifejackets have large single lobes that sits on the front of the abdomen and a neck support that provides buoyancy behind the head of the user.

The upper abdominal buoyancy device may be inflated by a gas cylinder and/or by means of a mouth piece.

Ideally, the harness does not have a crotch strap. In other words, the load is more evenly distributed to the thighs of the user, which can be important for encumbered users.

BRIEF DESCRIPTION OF THE DRAWINGS

An embodiment of the present invention will now be described with reference to the accompanying representations, of which:

Figure 1 is a schematic side view of an encumbered user wearing a floatation device including an upper abdominal lifejacket, an auxiliary floatation device attached to the legs of the user, and additional weight that may, for example, represent body armour, and a waist belt;

Figure 2 is a schematic side view of a user with arrows representing the weight and buoyancy forces acting on the body of the user relative to a line extending through the mouth of the user that is perpendicular to a longitudinal axis of the user, in which the "lever" effect of the auxiliary floatation device to control the orientation of the torso of the user is represented by D_1;

Figure 3 is an enlarge view of the head region of the user shown in figures 1 and 2, in which the torso of the user is located in a reclined or supine position by the auxiliary floatation device to increase the freeboard of the user;

Figure 4 is a picture of an encumbered soldier wearing 30 kg of body armour, a primary life jacket and the auxiliary floatation device;

Figure 5 is an enlarged view of the auxiliary floatation device illustrated in Figure 4; and

Figure 6 is graph illustrating the results of trials performed on seven different devices, in which trials 1 to 4 and trial 6 included the user wearing a primary lifejacket only, and trials 5 and 7 included the user wearing a primary life jacket and an auxiliary floatation device while the user is encumbered to varying degrees.

DETAILED DESCRIPTION

A preferred embodiment of a floatation device 20 will now be described with reference to the accompanying figures. Reference numerals have been included in the following description to help identify features of the preferred embodiment in the drawings. However, not all reference numerals have used in each Figure to maintain the clarity of the Figures.

The floatation device 20 includes a primary lifejacket 14 that is worn about the head or neck and the abdominal region of a user 13 and an auxiliary floatation device 11. The auxiliary floatation device 11 ideally includes two inflatable bladders 18, see Figures 4 and 5. Each of the bladders 18 may be attached to the thighs of a user 13 by means of a thigh harness including thigh straps 17 (see Figure 4) that extend about each thigh of a user 13 below the user's buttock.

In addition to providing additional buoyancy to assist in maintaining an encumbered user 13 afloat, the auxiliary floatation device 11 enables the orientation of the torso of the user 13 to be controlled and held in a relatively stable position in water. For example, Figure 1 illustrates the user 13 oriented in the supine position in which the frontal aspect of the user 13 forms an angle γ in the range of 30 to 60 degrees to the horizontal or the waterline 22. When the waterline 22 is calm with negligible waves, the orientation of the torso of the user 13 may be said to be held in equilibrium.

The physical phenomena that determines that static behaviour of a body immersed or partly immersed in a liquid is known as Archimedes principle. In summary, Archimedes principle states that a body immersed in a liquid is subjected by an upward force that is proportional to the amount of displaced liquid. In the case of lifejackets, a percentage of the lifejacket is underwater, which we refer to as the submerged volume that provides buoyancy, the remaining part of the lifejacket that is above the waterline 22 provides reserved buoyancy or additional buoyancy in the event that the user 13 is pulled beneath the water, a wave crashes over the user 13, and to cater for users 13 of different mass and different body types.

Figure 2 illustrates the weight of the person W_1, i.e., mass multiplied by gravity, the weight by which the person is encumbered W_2, and the buoyancy forces of the primary life jacket including buoyancy forces of the neck and head rest BF_3, buoyancy forces of the abdominal

section BF_2, and the auxiliary buoyancy BF_3 of the auxiliary floatation device 11. The buoyancy force applied by the liquid on the user's body, BF_4, is a function of the liquid displaced by the submerged parts of the user 13.

Controlling the angle of orientation of the torso of the user 13 in the water is a function of many parameters including the body type of the user, the location of the centre of mass of the user, the location of the centre of mass of the additional weight being carried by the user, the buoyancy forces of the lifejacket being worn by the user 13, and the "lever" effect of the buoyancy force BF_1 of the auxiliary floatation device 11. The lever effect of buoyancy force BF_1 can be expressed in terms of the normal portion of buoyancy force, namely BFN_1, multiplied by the distance D_1 to the frame of reference being the mouth of the user. As D_1 is significantly greater than D_4 and D_5 from the mouth of the user, the buoyancy force BF_1 of the auxiliary floatation device 11 has a major impact on the orientation of the longitudinal axis A-A of the torso of the user 13 in the water.

In summary, when the user 13 is in a stable orientation, or at equilibrium in the water, the sum of forces, namely the weight and the buoyancy should be equal. In addition, the sum of forces normal or the sum of the forces parallel to the longitudinal axis A-A of the torso of the user 13 should also be equal. Similarly, the static moments normal to the longitudinal axis of the torso of the user 13 can be expressed as follows:

$$D_1.BFN_1 + D_4BFN_2 + D_5.BFN_3 + D_3.BFN_4 = D_2.WN_2 + D_3WN_1 \quad \text{(equation 1)}$$

wherein

i) BF_1 is the buoyancy force of the auxiliary floatation device 11 and BFN_1 is the normal vector thereof,
ii) BF_2 is the buoyancy force of the chest portion of the lifejacket 14 and BFN_2 is the normal vector thereof,
iii) BF_3 is the buoyancy force of the head and neck region of the lifejacket 14 and BFN_3 is the normal vector thereof,
iv) BF_4 is the buoyancy force of the liquid acting the submerged portion of the body of the user 13 and BFN_4 is the normal vector thereof,
v) W_1 is the weight of the user 13 at their centre of mass and WN_1 is the normal vector thereof, and
vi) W_2 is the weight by which the user 13 encumbered and WN_2 is the normal vector thereof.

By controlling the angle of orientation of the torso of the user 13, we have discovered that the freeboard (see Figure 3) can also be significantly improved. For example, an encumbered user 13 may have a freeboard of less than 90mm when oriented upright in the water. Whereas, when the same user 13 is positioned in supine orientation as a result of the auxiliary buoyancy, the freeboard can increase to above 90mm and suitably in the range of 110 to 130mm, and even more particularly approximately 120mm.

As shown in Figure 3, the maximum freeboard for a user 13 wearing a lifejacket 14 and the auxiliary floatation device 11 will occur when the user 13 is oriented at an angle ɣ so that the longitudinal axis A-A of the torso of the user 13 is in the range of 30 to 60 degrees to the horizontal. In our experience when the angle of orientation of the torso of an encumbered user 13 is greater than 60 degrees to the horizontal, the user 13 is oriented too upright in the water and the freeboard will not be maximised. Similarly, when the angle of orientation less than 30 degrees to the horizontal, the user can be oriented too horizontal which can also result in a reduction of the freeboard.

It will be appreciated that the auxiliary floatation device 11 does not increase the total buoyancy force applied to the user 13 (i.e. the sum of BF_1, BF_2, BF_3 and BF_4) if the overall elevation of the user's body in the water remains the same i.e., the portion of the user body submerged remains the same.

In any event, the auxiliary floatation device 11 is capable of orienting the user 13 into a stable orientation while increasing the freeboard compared to the situation in which the user 13 is oriented in an essentially upright position in the water.

The magnitude of the lever effect of the auxiliary floatation device 11 can be changed by changing either the distance at which buoyancy force acts on the user 13 from the nominated reference point, or by changing the magnitude of the buoyancy force BF_1. While it may be possible to change the position of the auxiliary floatation device 11 on the user 13 prior to entering the water, once the user 13 is in the water it may be difficult to change the position of the auxiliary floatation device 11 on the user 13.

However, the degree to which the bladders 18 are inflated and hence the buoyancy force BF_1 can ideally be adjusted when the user 13 is in the water. By way of example, the user 13 may allow more gas to enter into the bladders 18 or vent gas from the bladders 18 when in the water. In one example, the bladders 18 may be inflated using any suitable means including a pressurised gas cylinder (not shown in the Figures) that can be opened via a valve to allow the contents of the gas cylinder to inflate the bladders 18. The valve may have an ON/OFF or open/closed position. The bladders 18 may also have a vent valve for venting gas from the bladders 18. The gas cylinder may contain any suitable gas, including relatively inert gases such as nitrogen and/or carbon dioxide.

As can be seen in Figures 4 and 5, illustrate the bladders 18 in an inflated condition. Ideally the auxiliary floatation device 11 can be inflated by the user 13 blowing into an oral inflation assembly having a hose 15 connected to an opening into one of the bladders 18. The oral inflation assembly may include a valve, such as a one way valve that allows the user 13 to inflate the bladders 18 to the required amount and thereafter remove their mouth from the hose 15 without the risk of the bladders 18 going flat by air being discharging therefrom. The degree to which the user 13 can inflate the bladders 18 can be based on the user's perception of their orientation in the water.

As can be seen in Figure 4 and 5, the hose 15 is self-coiling into a spiral formation preventing the hose from dangling or being a tripping hazard prior to the user 13 entering the water. The bladders 18 are also ideally interconnected by a passageway 16 that allows gas in one bladder 18 to pass to the other bladder 18 to allow the bladders 18 to be inflated simultaneously. In another embodiment not illustrated in the figures, there may be no passageway interconnecting the bladders 18 so gas is unable to pass from one bladder 18 to the other.

Alhtough not shown in the figures, the auxiliary floatation device 11 may include housings or similar valises about the size of the closed fist for storing the bladders in a compact deflatted condition. The or each housing may be atach to the tigh straps. The or each housing may have a length in the range of 10 to 15cm, a width in the range of 8 to 12cm and height in the range of 5 to 10 cm and is sized so that the housings interfere with normal military operations.

The lifejacket 10 worn by the user 13 may be any suitable device including for example, the lifejackets mentioned in Figure 6 namely the following lifejackets

Table 1:

Lifejacket buoyancy	
360N	Sample 1
275N	Sample 2
248N	Sample 3
275N	Sample 4
275N and the auxiliary floatation device 11 with a 100N buoyancy force	Sample 5
290N	Sample 6
290N and the auxiliary floatation device 11 with a 75N buoyancy	Sample 7

Ideally, the lifejacket 14 has a yoke or bib structure having an inflated head or neck rest portion, and an inflated chest portion. The chest portion of the yoke structure has two opposite lobes, and in the case of the bib structure, the chest portion is a single bladder. The lifejacket 10 may also include a first harness including a waist strap. The auxiliary floatation device 11 may also have a second harness including thigh straps 17 that extend about the legs of the user 13 below the user's buttock. Ideally, the lifejacket 10 is connected to the second harness of the auxiliary floatation device 11, for example, the thigh straps 17 and the waist strap may be interconnected.

Ideally, the buoyancy portions of the lifejacket 14 can be inflated, for example, may means of pressurised gas cylinders that are arranged to inflate the bladder(s) of the lifejacket 14. The lifejacket 14 may also have a mouth piece for oral inflation of the bladder(s).

With reference to Figure 6, Samples 1 to 4 are lifejackets that can provide the following freeboards 120mm, 120mm, 140mm and 160mm respectively of whether the user 13 is unladen user. However, when the user 13 is encumbered with 30 kg of additional weight, the freeboard for Samples 1 to 4 each reduces to approximately 40mm. In our view this freeboard is insufficient and significantly reduces the chances of survival of the user 13. In addition, the orientation of the torso of the user 13 was essentially uncontrolled and for Samples 1 to 4 was measured as being 52, 53.5, 65 and 71 degrees to the horizontal respectively when encumbered by 30 kg.

In contrast, Samples 5 and 6 comprise standard lifejackets 14 and the auxiliary floatation device 11 described herein. In the case of Sample 5, the freeboard for an unladen user 13 was approximately 160mm which reduced to approximately 120mm when encumbered by 15kg and 20kg respectively. The freeboard was measured as 80mm when encumbered with 30kg. In the case of Sample 7, the free board ranged from 155mm for an unladen user 13 to approximately 120 mm when the user 13 was encumbered by 30kg. In addition, the angle of orientation of the torso of the user 13 was controlled by the auxiliary floatation device 11 to angles of 50 and 57 degrees respectively when encumbered by 30 kg.

We believe that the trials demonstrate a strong correlation between controlling the orientation of the torso of the user 13 using the auxiliary floatation device 11 to increase and indeed, maximise freeboard.

It will be understood to persons skilled in the art of the invention that many modifications may be made without departing from the spirit and scope of the invention.

For example, the auxiliary floatation device 11 may include an angle indicator that provides the user with a reading providing an approximately angle of orientation of the torso of the user 13 in the water. The user 13 can then adjust the degree inflation of the bladders 18 of the auxiliary device, i.e. increase or decrease, and thereby control the orientation of their torso in the water and, in turn, adjust the freeboard of the user 13.

In addition, the tigh straps, waist harness and so forth may have any suitable quick release mechanism for dooning and doffing the auxiliary flotation device and/or the primary lifejacket.

CLAIMS

1. An auxiliary floatation device that can be used with a primary lifejacket worn by a user, the auxiliary floatation device includes a buoyancy portion that, in use, can be attached to the legs of the user, and the orientation of the torso of the user is controlled by the buoyancy force provided by the buoyancy portion and, in turn, effect the distance between the mouth of a user and waterline, which is referred to as the "freeboard".

2. The auxiliary floatation device according to claim 1, wherein the buoyancy force of the auxiliary device is, when in use, the result of the device being fully submerged.

3. The auxiliary floatation device according to claim 2, wherein the buoyancy force of the auxiliary floatation device controls the orientation of the torso of the user to automatically orientate into a reclined position in the water, and in this position the user's back is directed downward and the face of the user is directed upward.

4. The auxiliary floatation device according to claim 3, wherein when the user is in the reclined position in the water, the longitudinal axis of the torso of the user is in the range of 30 to 60 degrees to a horizontal waterline, measured in a forward direction of the user.

5. The auxiliary floatation device according to any one of claims 1 to 4, wherein the buoyancy portion has a single buoyancy element only that extends across the buttock or pelvic region of the user and the device has a harness that includes leg straps that extend about each leg of the user for attaching the device to the user.

6. The auxiliary floatation device according to any one of claims 1 to 5, wherein the buoyancy portion includes two buoyancy elements, and one of the buoyancy elements are attached to each thigh of the user, and suitably to each thigh of the user.

7. The auxiliary floatation device according to claim 6, wherein the auxiliary floatation device includes thigh straps that extend about the thighs of the user.

8. The auxiliary floatation device according to claim 7, wherein the thigh straps are removably connected to the buoyancy portion of the auxiliary floatation device using a quick attachment and release system.

9. The auxiliary floatation device according to claim 6, wherein the device includes a harness having a waist strap that, when in use, extends about the waist of the user and two legs straps extending from the waist strap, when in use, the leg straps extend about each leg of the user.

10. The auxiliary floatation device according to any one of the preceding claims, wherein the buoyancy portion has a buoyancy force up to 100N and suitably in the range of 10 to 100N.

11. The auxiliary floatation device according to any one of claims 1 to 10, wherein by increasing the buoyancy force the user can adjust their orientation into a more reclined position.

12. The auxiliary floatation device according to any one of claims 1 to 11, wherein by reducing the buoyancy force the user can adjust their orientation into a more upright position.

13. The auxiliary floatation device according to any one of claims 1 to 12, wherein the buoyancy portion includes at least one inflatable bladder, and the user can control the buoyancy force by increasing the degree of inflation of the bladder.

14. The auxiliary floatation device according to claim 13, wherein the auxiliary floatation device includes an oral inflation assembly that is arranged to allow a user wearing the auxiliary device to inflate the or each bladder by blowing from their mouth, and thereby the oral inflation assembly may include a hose and a one way valve that allows a person to blow into the hose to inflate the or each bladder.

15. The auxiliary floatation device according to claim 13 or 14, wherein the user can adjust the buoyancy force of the auxiliary floatation device by changing the degree to which the bladder(s) are inflated, and in turn, control the orientation of the torso of the user and improve the mouth freeboard.

16. The auxiliary floatation device according to any one of claims 13 to 15, wherein the floatation device has a vent that the user can open and close to reduce the degree to which the bladder(s) is inflated.

17. The auxiliary floatation device according to any one of claims 13 to 16, wherein the hose may be self-retracting the hose may be arranged in a coil formation, that can be pulled out to an extended form and auto-retract into a coiled retracted form.

18. The auxiliary floatation device according to any one of claims 13 to 17, wherein the auxiliary floatation device may include a pressurised gas cylinder that is arranged to inflate the or each bladder.

19. The auxiliary floatation device according to claim 18, wherein the user can control the degree to which the or each bladder is inflated by controlling gas flow from the cylinder into the or each bladder and, in turn, enable the buoyancy force of the lower buoyancy to be adjusted to control the orientation of the torso of the user.

20. The auxiliary floatation device according to claims 18 or 19, including an ON/OFF valve for controlling the gas flow into the bladders, and a release bleed valve to control the flow of gas from the bladders.

21. The auxiliary floatation device according to any one of claims 13 to 20, wherein the device includes at least one openable housing for containing at least one of the inflatable bladders in a compact configuration for storage while deflated.

22. The auxiliary floatation device according to any one of claims 13 to 20, wherein the auxiliary device includes two openable housings, one of the housings from each bladder.

23. The auxiliary floatation device according to any one of claims 13 to 20, wherein each housing is ideally attached to the thigh straps.

24. The auxiliary floatation device according to any one of claims 13 to 20, wherein the or each housing has a length in the range of 10 to 15cm, a width in the range of 8 to 12cm and height in the range of 5 to 10 cm, such that the or each bladder in a deflated condition can be stored in the housings and so that the auxiliary floatation device does not to interfere with normal military operations.

25. A floatation device for encumbered users including:

a harness having a waist strap that extends about the waist of a user and at least one thigh strap that extends about a leg of a user below the buttock of the user;

an upper abdominal buoyancy portion that is attached to the waist strap of the harness; and

a lower buoyancy portion that is attachable to the thigh strap;

wherein the orientation of the body of the user in the water is able to be controlled by the buoyancy force provided by the lower buoyancy portion and, in turn, effect the freeboard.

26. The floatation device according to claim 25, wherein the lower buoyancy portion is the auxiliary floatation device according to any one of claims 1 to 24.

27. The flotation device according to claim 25 or 26, wherein the harness does not have a crotch strap.

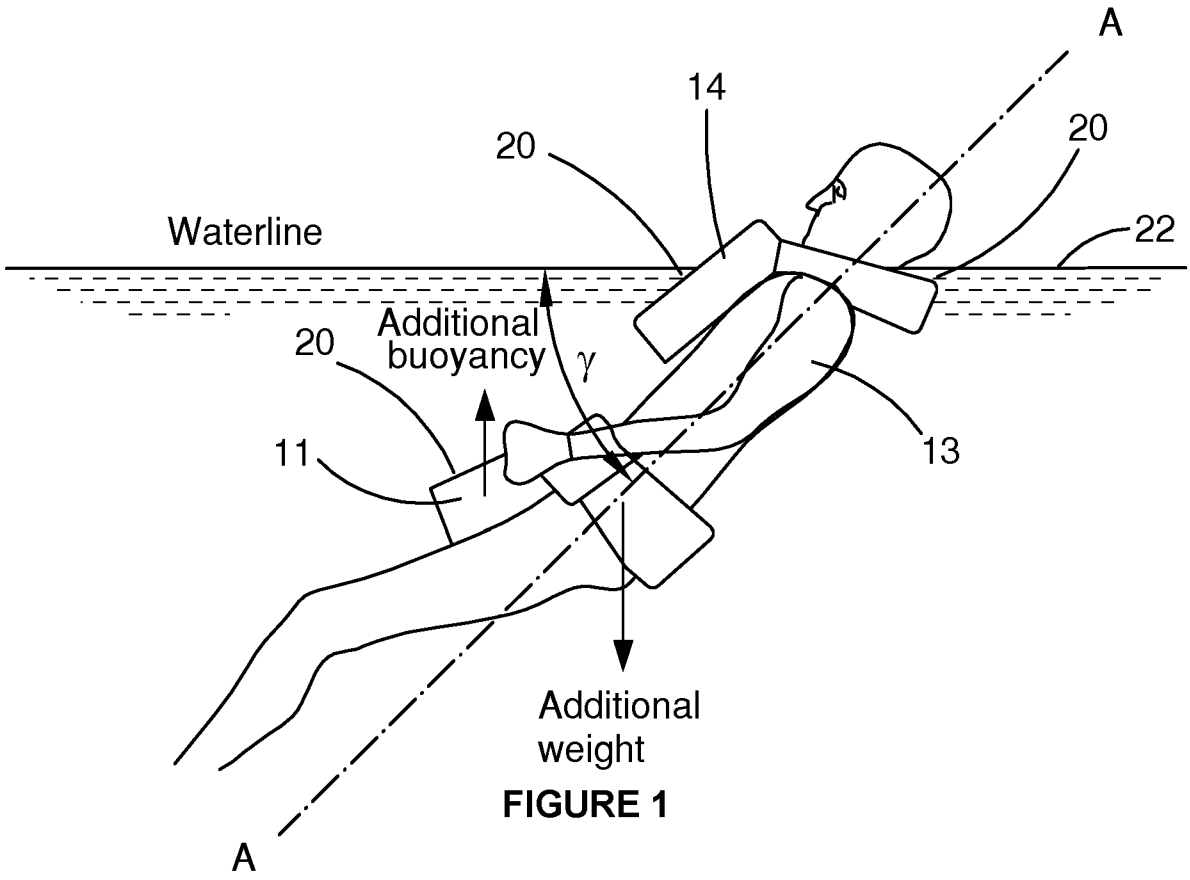


FIGURE 1

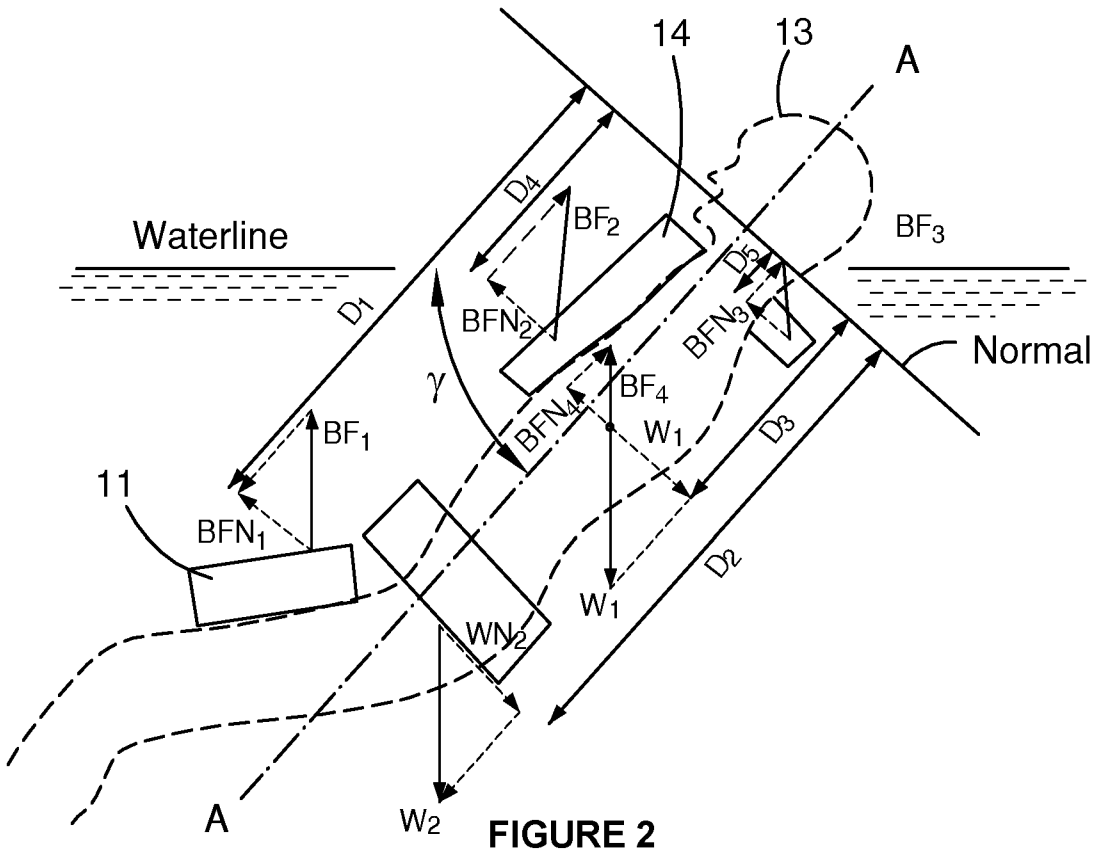


FIGURE 2

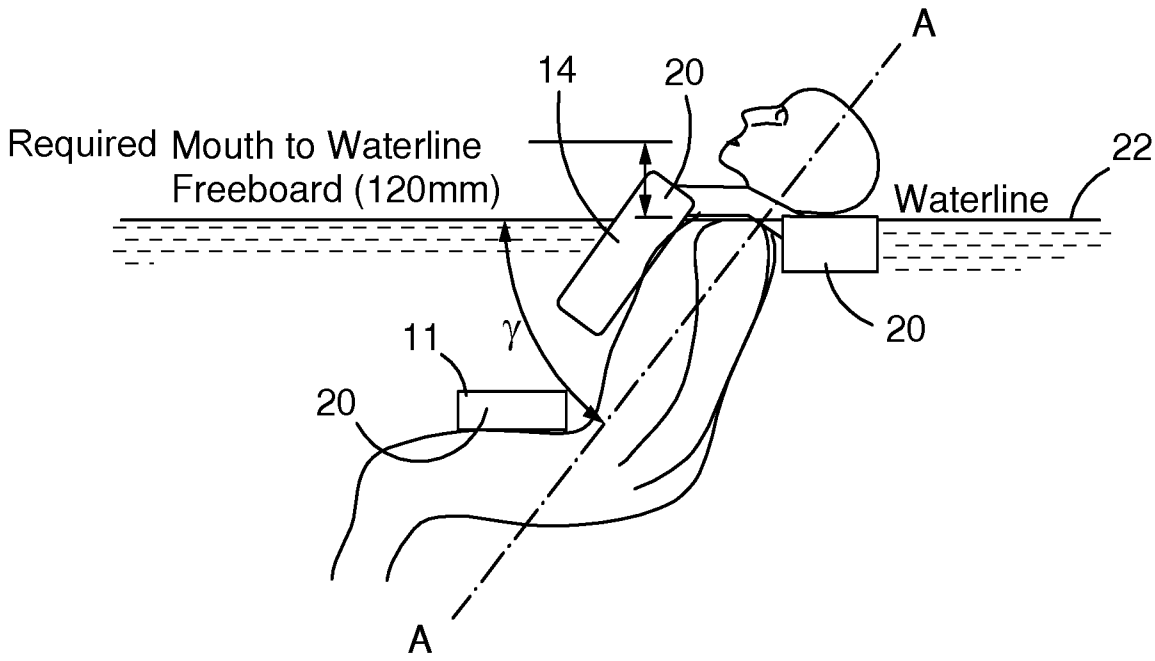

A
14
20
Required Mouth to Waterline
Freeboard (120mm)
22
Waterline
20
11
γ
20
A

FIGURE 3

Figure 4

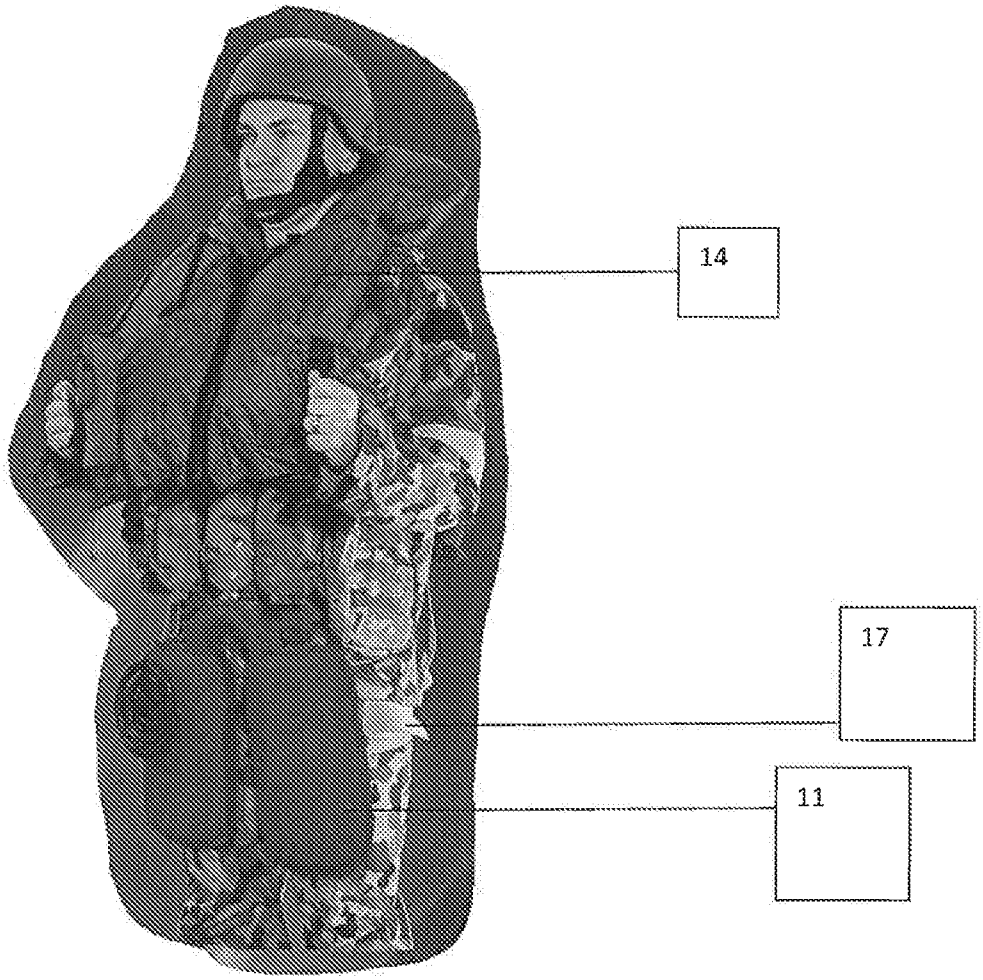
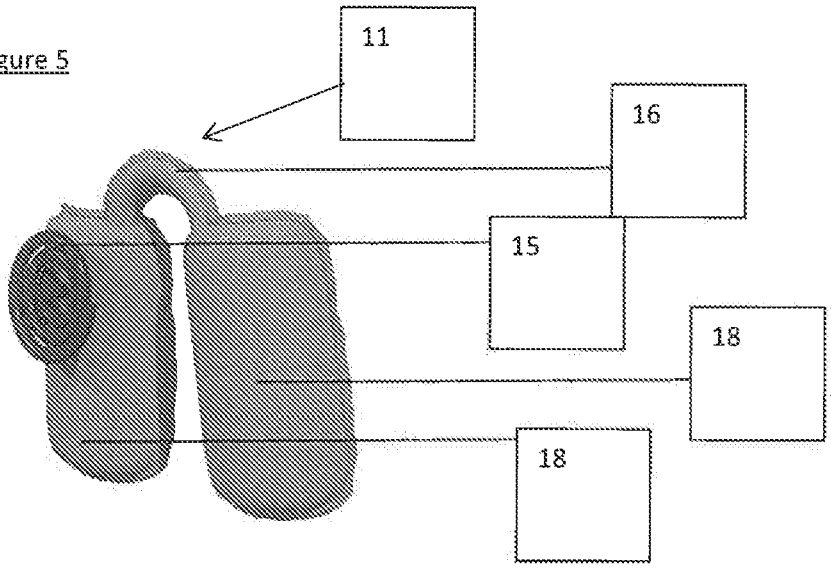


Figure 5



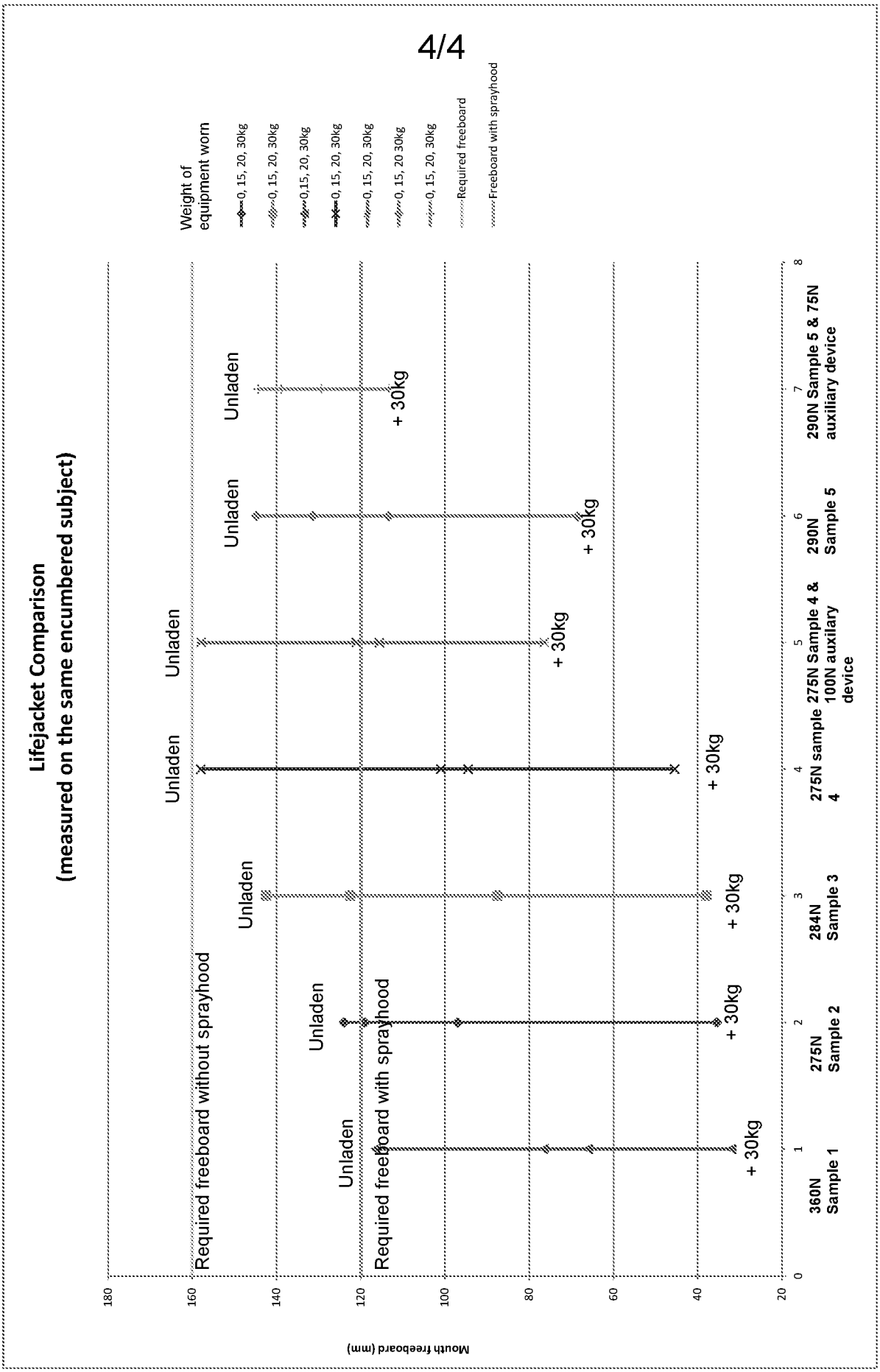

Lifejacket Comparison
(measured on the same encumbered subject)
Mouth freeboard (mm)
Weight of equipment worn
0, 15, 20, 30kg
Required freeboard
Freeboard with sprayhood
Required freeboard without sprayhood
Required freeboard with sprayhood
Unladen
+ 30kg
360N Sample 1
275N Sample 2
284N Sample 3
275N sample 4
275N Sample 4 & 100N auxiliary device
290N Sample 5
290N Sample 5 & 75N auxiliary device

Figure 6

INTERNATIONAL SEARCH REPORT

International application No.
PCT/AU2016/050925

A. CLASSIFICATION OF SUBJECT MATTER

B63C 9/13 (2006.01) B63C 9/08 (2006.01)

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)

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 practicable, search terms used)

Database WPIAP, EPODOC search with IPC/CPC mark B63C9/155, B63C9/08/low, B63C9/13/low and keywords: torso, orientation, incline, control, buoyancy, flotation, thigh and similar terms. Auspat inventor search: "Drohan, David" as the inventor; Auspat applicant search: "the Commonwealth of Australia"; Espacenet inventor search with keyword:"Drohan David"as the inventor; Espacenet applicant search with keywords "the commonwealth of Australia"; Espacenet search with mark B63C9/13 and keywords : torso, orientation, incline, control, buoyancy, flotation, thigh and like terms. Google patents search with keywords: torso, orientation, incline, control, buoyancy, flotation, thigh & similar terms. Inventor/Applicant search done in internal databases of IP Australia

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
	Documents are listed in the continuation of Box C	

[X] Further documents are listed in the continuation of Box C [X] See patent family annex

* Special categories of cited documents:

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"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

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
22 December 2016	22 December 2016
Name and mailing address of the ISA/AU	**Authorised officer**
AUSTRALIAN PATENT OFFICE PO BOX 200, WODEN ACT 2606, AUSTRALIA Email address: pct@ipaustralia.gov.au	Gang Shen AUSTRALIAN PATENT OFFICE (ISO 9001 Quality Certified Service) Telephone No. 0262832458

INTERNATIONAL SEARCH REPORT C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		International application No. **PCT/AU2016/050925**
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 5562514 A (ROWE) 08 October 1996 Figure 1,5,6 col.3 lines 51-61	1-4, 5-6, 10-12
X	US 2002/0009934 A1 (WATLER) 24 January 2002 figure 1, 6 and the description	1-4, 5-6, 10-12
Y	US 2013/0295804 A1 (SENN) 07 November 2013 figure 1 and [0024] of the description	13-24
X	DE 3047296 A1 (KOOPS FRANZ PETER) 29 July 1982 see figures	1-4, 5-6, 10-12
X	CN 202783737 U (ZHU YANFANG) 13 March 2013 see figures	1-6, 9-12, 25-27
X Y	CN 200997924 Y (GUANGHUA WANG) 02 January 2008 see figures see figures and [0024] of the description	1-4, 6-8, 10-12, 25-27 13-24
X	CN 203528785 U (MENG CHAOWEN et al) 09 April 2014 see figures	1

INTERNATIONAL SEARCH REPORT Information on patent family members	International application No. **PCT/AU2016/050925**

This Annex lists known patent family members relating to the patent documents cited in the above-mentioned international search report. The Australian Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

Patent Document/s Cited in Search Report		**Patent Family Member/s**	
Publication Number	**Publication Date**	**Publication Number**	**Publication Date**
US 5562514 A	08 October 1996	US 5562514 A	08 Oct 1996
US 2002/0009934 A1	24 January 2002	US 2002009934 A1	24 Jan 2002
US 2013/0295804 A1	07 November 2013	US 2013295804 A1	07 Nov 2013
		US 8979605 B2	17 Mar 2015
		US 2012244767 A1	27 Sep 2012
		US 8790147 B2	29 Jul 2014
DE 3047296 A1	29 July 1982	DE 3047296 A1	29 Jul 1982
CN 202783737 U	13 March 2013		
CN 200997924 Y	02 January 2008	None	
CN 203528785 U	09 April 2014		

End of Annex

Due to data integration issues this family listing may not include 10 digit Australian applications filed since May 2001.