



A FLOATING STRUCTURE FOR GUN AND MISSILE TARGETING, A METHOD FOR PROVIDING THE AFOREMENTIONED, AND CONSTITUENT COMPONENTS

5 FIELD OF INVENTION

The field of this invention lies within the field of gun and missile targeting. In particular, it lies within the specific field of water-borne floating structures used for gun and missile targeting.

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BACKGROUND

In any armed forces in the world, it is mandatory for weapons training to be carried out to hone the wartime competencies of the armed forces even during
15 peacetime situations. Even though many forms of weapons training are able to be carried out through the use of repetitive drills and simulations, it is typical for "live" weapons training to be regularly carried out to ensure the wartime competencies of the armed forces are maintained at an effective level.

20 Gunnery or missile firing at naval targets are typical training exercises for all military navies. The naval targets usually range in length from 30 m to 80 m. It is common for these firings to take place in the open sea which are preferably a substantial distance from shipping lanes and land masses in order to minimize the risk of accidents. However, the movement of the naval targets to the
25 requisite firing locations using either self propulsion or towing by another seaborne vessel can be hampered by poor sea conditions leading to undesirable delays and consequently an inability to use preferred firing locations. In instances when the munitions involved are able to potentially cause large scale damage, the substantial distance required for travel of the naval
30 targets to the preferred firing location typically involve substantial logistics planning and resources to ensure that the naval targets are undamaged and still usable on arrival at the preferred firing location.



In addition, subsequent to the cessation of the gunnery or missile firing exercises, during instances when the naval target(s) is damaged as a result of the firing exercises, the transportation of the damaged naval target(s) to a storage/assessment facility may be compromised due to a loss of stability of the damaged naval target(s). On-site repairs to a damaged naval target(s) is typically difficult under most sea conditions.

The difficulties faced in repairing the damaged naval target(s) often restrict the number of instances that each naval target can be fired upon. This is highly undesirable in view of the substantial planning and resources needed to transport the naval target(s) to the preferred firing location prior to the start of the firing exercises.

Thus, it would be desirable if large naval targets are easily transportable to-and-from the preferred firing location and are also in a form that is easily repairable so as to maximize the usability of the naval target(s) deployed at the firing location.

SUMMARY

In a first aspect, there is provided a floating structure for gun and missile targeting. The structure includes a plurality of independently buoyant modules releasably connected to each other and at least one stability system coupled to at least one portion of the plurality of independently buoyant modules at an intermediate structure of the at least one stability system, the at least one stability system also including a buoyant body. It is advantageous that the at least one stability system changes a buoyancy of the floating structure by immersing the buoyant body in water at different depths.

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The intermediate structure of the at least one stability system may be attached by a plurality of hydraulic actuators either directly to the buoyant body or a base

structure coupled to the buoyant body. It is advantageous that activation of the plurality of hydraulic actuators causes an orientation of the buoyant body to vary and immerses the buoyant body in water at different depths.

- 5 It is preferable that every module of the plurality of independently buoyant modules is different to one another. Each of the plurality of independently buoyant modules may preferably include a plurality of engagement slots located along a perimeter edge of each independently buoyant module.
- 10 Preferably, a first face of each of the plurality of independently buoyant modules includes a secondary slot along the first face, the secondary slot being parallel to a first edge of the first face. The plurality of engagement slots may be perpendicular to the secondary slot. Each end of the secondary slot may be a tapered channel.

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- It is preferable that a second face of each of the plurality of independently buoyant modules includes a lip along the second face, the lip being parallel to a second edge of the second face. A third face and a fourth face of each of the plurality of independently buoyant modules may preferably include both a
- 20 receptor for receiving a guide structure of another independently buoyant module and a guide structure that fits within the receptor of another independently buoyant module.

- Preferably, all of the plurality of engagement slots, the secondary slot, the
- 25 tapered channels, the lip, and both the receptor and the guide structure are surface coated with a material with low friction coefficient.

- In a second aspect, there is provided a method for providing a floating structure for gun and missile targeting, whereby the floating structure comprises a
- 30 plurality of independently buoyant modules. The method includes varying a buoyancy of at least one of the plurality of independently buoyant modules subsequent to the gun and missile targeting; and configuring at least one

stability system coupled to at least portion of the plurality of independently buoyant modules at an intermediate structure of the at least one stability system to change a buoyancy of the floating structure, the at least one stability system including a buoyant body. It is advantageous that the buoyancy of the floating structure changes when the buoyant body of the at least one stability system is immersed at different depths.

In a third aspect, there is provided an independently buoyant module suitable for use with a floating structure for gun and missile targeting. The independently buoyant module includes a plurality of engagement slots located along a perimeter edge of each independently buoyant module; a secondary slot along a first face, the secondary slot being parallel to a first edge of the first face; tapered channels at each end of the secondary slot; a lip along a second face, the lip being parallel to a second edge of the second face, and the lip being locatable within the secondary slot of another independently buoyant module; and a receptor for receiving a guide structure of another independently buoyant module and the guide structure fits within the receptor of another independently buoyant module on both a third face and a fourth face.

In a final aspect, there is provided a stability system suitable for use with a floating structure for gun and missile targeting. The stability system includes a buoyant body; an intermediate structure for coupling the stability system with at least one face of the floating structure; and a plurality of hydraulic actuators attached to the intermediate structure either directly to the buoyant body or a base structure coupled to the buoyant body. It is advantageous that the buoyancy of the floating structure changes when the buoyant body of the at least one stability system is immersed at different depths.

DESCRIPTION OF DRAWINGS

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In order that the present invention may be fully understood and readily put into practical effect, there shall now be described by way of non-limitative example

only preferred embodiments of the present invention, the description being with reference to the accompanying illustrative drawings.

Figure 1 shows a front perspective view of an independently buoyant module
5 used in a floating structure of the present invention.

Figure 2 shows a rear perspective view of the independently buoyant module of Figure 1.

Figure 3 shows a first side face of the independently buoyant module of Figure 1.

10 Figure 4 shows a top view of the independently buoyant module of Figure 1.

Figure 5 shows a first breadth face of the independently buoyant module of Figure 1.

Figure 6 shows a first example of the floating structure of the present invention.

15 Figure 7 shows a side view of a stability system used in the floating structure of the present invention.

Figure 8 shows a side view of a second example of the floating structure of the present invention.

Figure 9 shows a side view of the second example of the floating structure of the present invention when the stability system is in use.

20 Figure 10 shows a process flow for a method for providing a floating structure for gun and missile targeting.

DESCRIPTION OF PREFERRED EMBODIMENTS

25 Referring to Figure 6, there is shown a first example of a floating structure 20 for gun and missile targeting. In the first example, the floating structure 20 is shown to include a plurality of independently buoyant modules 22 releasably connected to each other. Although the modules 22 shown in Figure 6 appear to be substantially identical, it should be noted that every module 22 of the plurality
30 of independently buoyant modules 22 may be different from one another. Given the use of the floating structure 20 for gun and missile targeting, the floating structure 20 may be of a scale similar to that of a marine hull and superstructure,

possibly large enough to be detectable by gun/missile targeting systems such as radar over extended distances. Each of the independently buoyant modules 22 may be a pontoon which will be described in greater detail in subsequent paragraphs.

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Referring to Figure 1, there is shown a front perspective view of an independently buoyant module 22 used in the floating structure 20. Figure 1 clearly shows a third face 30, a first face 32, and a top face 34 of the independently buoyant module 22. Referring to Figure 2, there is shown a rear
10 perspective view of the independently buoyant module 22 used in the floating structure 20. Figure 2 clearly shows the top face 34, a fourth face 36, and a second face 38. It should be noted that faces which are not shown in Figures 1 and 2 are still labeled for the sake of clarity. Corresponding labels will also be included in Figures 3 to 5 for the sake of clarity. It should be noted that while the
15 independently buoyant module 22 is shown to be in a rectangular form but it may be in a cubical form as well.

The independently buoyant module 22 includes a plurality of engagement slots 42 located along a perimeter edge 40 of each independently buoyant module 22.
20 The engagement slots 42 as shown in Figures 1 – 5 are in such a form to enable effective coupling with an appropriately shaped detachable locking bar (not shown). As such, the engagement slots 42 need not necessarily be in the form as shown in Figures 1 – 5.

25 The first face 32 of the independently buoyant module 22 includes a secondary slot 44 along the first face 32. The secondary slot 44 may be parallel to a first edge 33 of the first face 32. The secondary slot 44 may be perpendicular to the plurality of engagement slots 42. Each end of the secondary slot 44 is a tapered channel 46. The tapered channel 46 may be either v-shaped (as shown in the
30 figures) or funnel-shaped such that coupling of one independently buoyant module 22 to another independently buoyant module 22 is at the first face 32 is made easier as the independently buoyant modules 22 are likely to experience

bobbing when the independently buoyant modules 22 are floating in the open sea.

5 The second face 38 of each of the plurality of independently buoyant modules 22 includes a lip 48 along the second face 38. The lip 48 is for enabling ease of coupling between the independently buoyant modules 22 in a manner where the lip 48 fits within the secondary slot 44 along the first face 32 of another independently buoyant module 22.

10 In addition, the third face 30 and the fourth face 36 of each of the plurality of independently buoyant modules 22 include both a receptor 50 and a guide structure 52. It should be noted that a distance between the receptor 50 and the guide structure 52 on each of the third face 30 and the fourth face 36 is substantially identical, but the arrangement of the receptor 50 and the guide structure 52 are opposite for each of the third face 30 and the fourth face 36.
15 This different arrangement of the receptor 50 and the guide structure 52 for the third face 30 and the fourth face 36 also enables ease of coupling between the independently buoyant modules 22 in a manner where the guide structure 52 on the third face 30 of one independently buoyant module 22 fits into the receptor 50 on the fourth face 36 of another independently buoyant module 22.
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It should be noted that each independently buoyant module 22 is able to couple with other independently buoyant modules 22 along the third face 30, the fourth face 36, the first face 32 and the second face 38. The coupling between the
25 independently buoyant modules 22 is enabled by the use of at least one of the plurality of engagement slots 42, the secondary slot 44, the tapered channels 46, the lip 48, and both the receptor 50 and the guide structure 52. The plurality of engagement slots 42, the secondary slot 44, the tapered channels 46, the lip 48, and both the receptor 50 and the guide structure 52 are surface coated with
30 a material with low friction coefficient to enable sliding and correspondingly improve the manner which the independently buoyant modules 22 are coupled with one another. An example of a material with low friction coefficient is Teflon.

When the plurality of the independently buoyant modules 22 are coupled with each other, the floating structure 20 may be in a form as shown in Figure 6. While a substantially rectangular floating structure 20 is shown in Figure 6, the floating structure 20 may be of any possible shape so as to better represent actual naval targets to both the naked eye and the gun/missile targeting systems. Figure 6 shows the removal of a damaged independently buoyant module 22(D). The damaged independently buoyant module 22(D) is removed for damage assessment so as to determine accuracy of the gun and missile targeting. In addition, the floating structure 20 remains at an even keel when in the water after replacing the damaged independently buoyant module 22(D) with an undamaged independently buoyant module 22. It should be noted that the replacement of the damaged independently buoyant module 22(D) enables the floating structure 20 to remain deployable as a naval target. It is likely that the replacement of the damaged independently buoyant module 22(D) is carried out on-site where the floating structure 20 was fired upon.

In an alternative embodiment as shown in Figures 7 – 9, the floating structure 20 may also include at least one stability system 60. The stability system 60 includes a buoyant body 62, a base structure 64 coupled to the buoyant body 62 and an intermediate structure 66 for coupling the stability system 60 with at least one portion of the plurality of the independently buoyant modules 22 of the floating structure 20. However, the base structure 64 may be omitted if the buoyant body 62 is structurally resilient and able to support the stability system 60. The intermediate structure 66 may include similar coupling structures to those found on each independently buoyant module 22, such as, for example, plurality of engagement slots, the secondary slot, the tapered channels, the lip, and both the receptor and the guide structure and so forth such that the at least one stability system 60 is able to couple to at least one portion of the plurality of the independently buoyant modules 22 of the floating structure 20.

The base structure 64 is attached to the intermediate structure 66 by a plurality of hydraulic actuators 68, 70. Other actuating mechanisms may also be used in place of the hydraulic actuators 68, 70. It is preferable that the other actuating mechanisms are both resilient to conditions where the floating structure 20 is
5 deployed (sea conditions) and controllable under the aforementioned conditions. The hydraulic actuators 68, 70 may be attached in a manner where activation of the plurality of hydraulic actuators 68, 70 (via either extension or retraction of rods 72, 74) causes an orientation of the intermediate structure 66 to vary. Referring to Figures 8 and 9, when the floating structure 20 is coupled to the
10 intermediate structure 66 (and consequently the stability system 60), activation of the plurality of hydraulic actuators 68, 70 from a first state in Figure 8 to a second state in Figure 9 causes the floating structure 20 to remain at an even keel when in the water (as shown in the even keel of the floating structure 20 with reference to the water level 90 in Figure 9) when there is a change in a
15 buoyancy of the floating structure 20 due to damage to the at least one of the plurality of independently buoyant modules 22 (as shown in the uneven keel of the floating structure 20 with reference to the water level 90 in Figure 8). Thus, the stability system 60 compensates for the loss of buoyancy of the damaged floating structure 20 by immersing the buoyant body 62 in water at different
20 depths.

Thus, it is evident that the aforementioned embodiments of the floating structure 20 enables the floating structure 20 to remain at an even keel subsequent to being damaged by gunnery shells or missiles. It is desirable that the floating
25 structure 20 remains at an even keel to ensure that the floating structure 20 remains usable as a gunnery/missile target. The modular nature of the floating structure 20 also enables ease of transportation of the floating structure 20. The modular nature of the floating structure 20 also allows variation in an appearance of the floating structure 20 and there is thus no necessity to
30 transport naval targets of varying forms.

Referring to Figure 10 which shows a method aspect of the present invention. The method aspect correlate to the use of the floating structure 20 as described in the preceding paragraphs and correspondingly, identical labels found in Figures 1 – 9 are also used in the subsequent paragraphs describing the method.

In a first method embodiment, there is provided method 110 for providing a floating structure 20 for gun and missile targeting. The floating structure 20 may be of the forms described in the preceding paragraphs, whereby the floating structure 20 comprises a plurality of independently buoyant modules 22.

The floating structure 20 need not resemble what is depicted in Figure 6. Given the use of the floating structure 20 for gun and missile targeting, the floating structure 20 may be of a scale similar to that of a marine superstructure, possibly large enough to be detectable by gun/missile targeting systems such as radar over extended distances. Every module of the plurality of independently buoyant modules 22 forming the floating structure 20 may be different from one another.

The method 110 includes varying a buoyancy of at least one of the plurality of independently buoyant modules 22 subsequent to the gun and missile targeting (114). Damage sustained (for example, a puncture) by the at least one of the plurality of independently buoyant modules 22 forming the floating structure 20 due to gun and missile targeting causes the buoyancy for the at least one of the plurality of independently buoyant modules 22 to vary.

Finally, the method 110 includes configuring at least one stability system 60 coupled to at least one portion of the plurality of independently buoyant modules 22 at an intermediate structure 66 of the at least one stability system 60 to change a buoyancy of the floating structure 20 (116). The stability system 60 may be identical to that described in the preceding paragraph and includes a buoyant body 62, a base structure 64 coupled to the buoyant body 62 and the

intermediate structure 66 for coupling the stability system 60 with the floating structure 20. The base structure 64 may be omitted if the buoyant body 62 is structurally resilient and able to support the stability system 60.

5 The base structure 64 is attached to the intermediate structure 66 by a plurality of hydraulic actuators 68, 70. Other actuating mechanisms may also be used in place of the hydraulic actuators 68, 70. It is preferable that the other actuating mechanisms are both resilient to conditions where the floating structure 20 is deployed (sea conditions) and controllable under the aforementioned conditions.

10 The hydraulic actuators 68, 70 may be attached in a manner where activation of the plurality of hydraulic actuators 68, 70 (via either extension or retraction of rods 72, 74) causes an orientation of the intermediate structure 66 to vary. Referring to Figures 8 and 9, when the floating structure 20 is coupled to the intermediate structure 66 (and consequently the stability system 60), activation

15 of the plurality of hydraulic actuators 68, 70 from a first state in Figure 8 to a second state in Figure 9 causes the floating structure 20 to remain at an even keel when in the water (as shown in the even keel of the floating structure 20 with reference to the water level 90 in Figure 9) when there is a change in a buoyancy of the floating structure 20 due to damage to the at least one of the

20 plurality of independently buoyant modules 22 (as shown in the uneven keel of the floating structure 20 with reference to the water level 90 in Figure 8). Thus, the stability system 60 compensates for the loss of buoyancy of the damaged floating structure 20 by immersing the buoyant body 62 in water at different depths.

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Therefore, it should be evident that the aforementioned method 110 enables the floating structure 20 to remain at an even keel subsequent to being damaged by gunnery shells or missiles. It is desirable that the method 110 enables the floating structure 20 to remain at an even keel to ensure that the floating

30 structure 20 remains usable as a gunnery/missile target.

Whilst there has been described in the foregoing description preferred embodiments of the present invention, it will be understood by those skilled in the technology concerned that many variations or modifications in details of design or construction may be made without departing from the present invention.

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CLAIMS

1. A floating structure for gun and missile targeting, the structure including:
a plurality of independently buoyant modules releasably connected to
5 each other; and
at least one stability system coupled to at least one portion of the plurality
of independently buoyant modules at an intermediate structure of the at least
one stability system, the at least one stability system also including a buoyant
body,
10 wherein the at least one stability system changes a buoyancy of the
floating structure by immersing the buoyant body in water at different depths.
2. The floating structure of claim 1, wherein every module of the plurality of
independently buoyant modules is different to one another.
- 15 3. The floating structure of either claim 1 or 2, wherein each of the plurality
of independently buoyant modules includes a plurality of engagement slots
located along a perimeter edge of each independently buoyant module.
- 20 4. The floating structure of any one of claims 1 – 3, wherein a first face of
each of the plurality of independently buoyant modules includes a secondary
slot along the first face, the secondary slot being parallel to a first edge of the
first face.
- 25 5. The floating structure of either claim 3 or 4, wherein the plurality of
engagement slots is perpendicular to the secondary slot.
6. The floating structure of either claim 4 or 5, wherein each end of the
secondary slot is a tapered channel.

7. The floating structure of any one of claims 1 – 6, wherein a second face of each of the plurality of independently buoyant modules includes a lip along the second face, the lip being parallel to a second edge of the second face.

5 8. The floating structure of any one of claims 1 – 7, wherein a third face and a fourth face of each of the plurality of independently buoyant modules include both a receptor for receiving a guide structure of another independently buoyant module and a guide structure that fits within the receptor of another independently buoyant module.

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9. The floating structure of claim 8, wherein all of the plurality of engagement slots, the secondary slot, the tapered channels, the lip, and both the receptor and the guide structure are surface coated with a material with low friction coefficient.

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10. The floating structure of claim 1, wherein the intermediate structure of the at least one stability system is attached by a plurality of hydraulic actuators either directly to the buoyant body or a base structure coupled to the buoyant body, and wherein activation of the plurality of hydraulic actuators causes an
20 orientation of the buoyant body to vary and immerses the buoyant body in water at different depths.

11. A method for providing a floating structure for gun and missile targeting, the floating structure comprising a plurality of independently buoyant modules,
25 the method including:

varying a buoyancy of at least one of the plurality of independently buoyant modules subsequent to the gun and missile targeting; and

configuring at least one stability system coupled to at least portion of the plurality of independently buoyant modules at an intermediate structure of the at
30 least one stability system to change a buoyancy of the floating structure, the at least one stability system including a buoyant body;

wherein the buoyancy of the floating structure changes when the buoyant body of the at least one stability system is immersed at different depths.

12. An independently buoyant module suitable for use with a floating
5 structure for gun and missile targeting, the independently buoyant module including:

a plurality of engagement slots located along a perimeter edge of each independently buoyant module;

10 a secondary slot along a first face, the secondary slot being parallel to a first edge of the first face;

tapered channels at each end of the secondary slot;

a lip along a second face, the lip being parallel to a second edge of the second face, and the lip being locatable within the secondary slot of another independently buoyant module; and

15 a receptor for receiving a guide structure of another independently buoyant module and the guide structure fits within the receptor of another independently buoyant module on both a third face and a fourth face.

13. A stability system suitable for use with a floating structure for gun and
20 missile targeting, the stability system including:

a buoyant body;

an intermediate structure for coupling the stability system with at least one face of the floating structure; and

25 a plurality of hydraulic actuators attached to the intermediate structure either directly to the buoyant body or a base structure coupled to the buoyant body,

wherein the buoyancy of the floating structure changes when the buoyant body of the at least one stability system is immersed at different depths.