Nov. 16, 1965 D. B. MEEKER 3,217,599

MISSILE LAUNCHING APPARATUS

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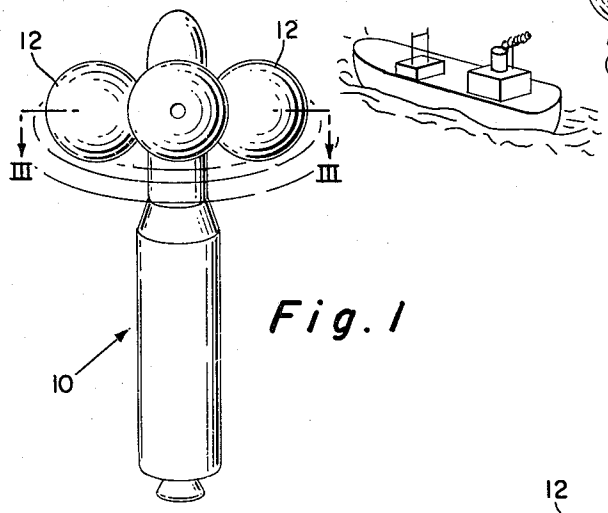


Fig. 1

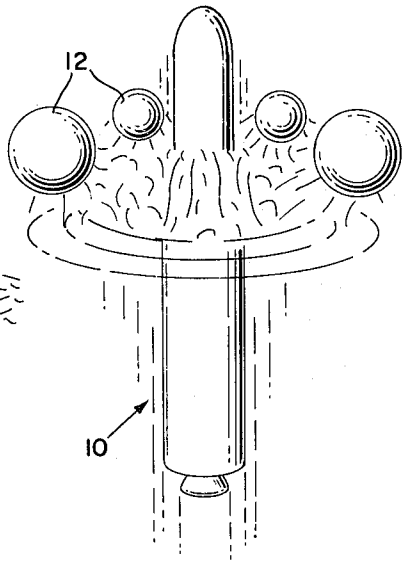


Fig. 5

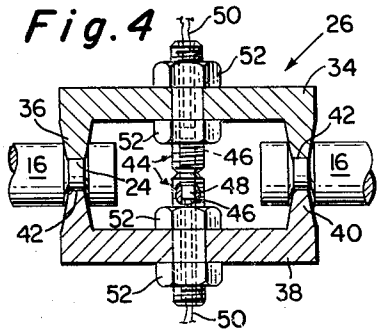


Fig. 4

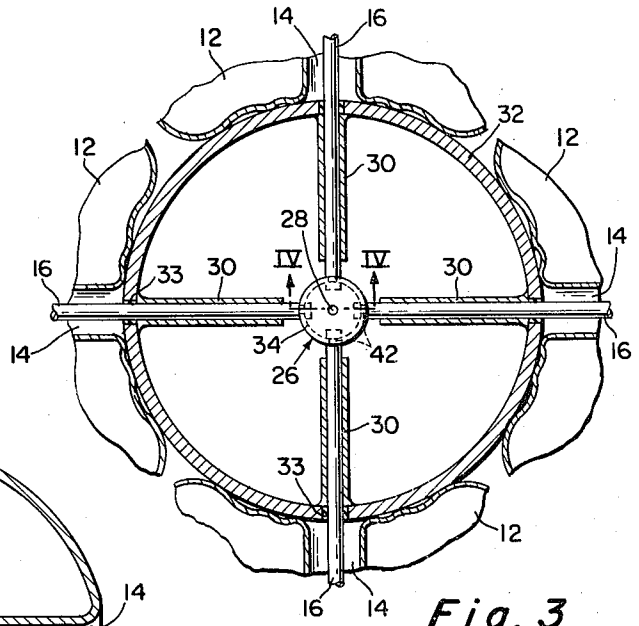


Fig. 3

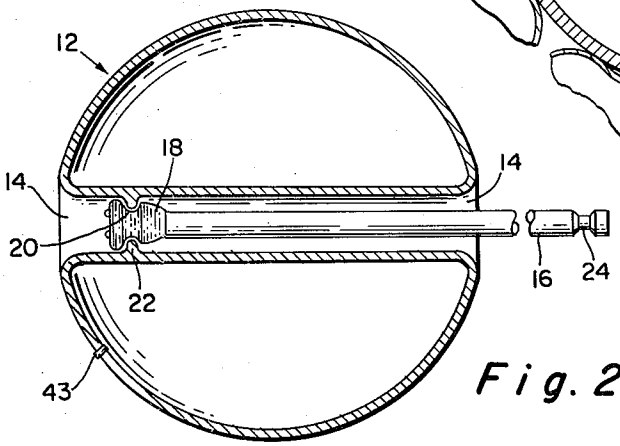


Fig. 2

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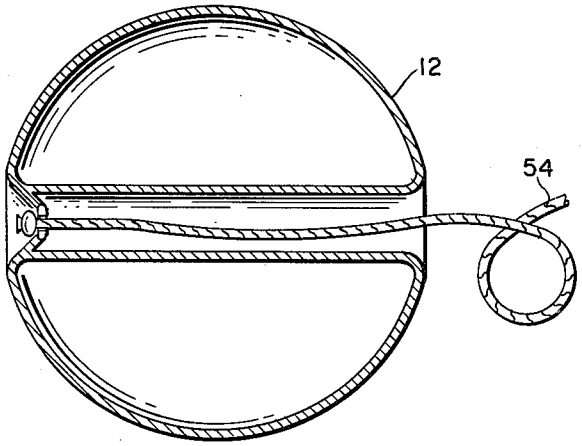
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MISSILE LAUNCHING APPARATUS

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Fig. 6



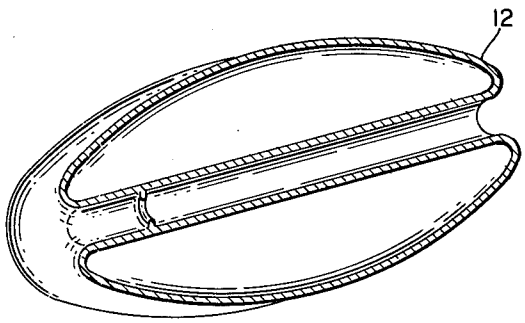


Fig. 7

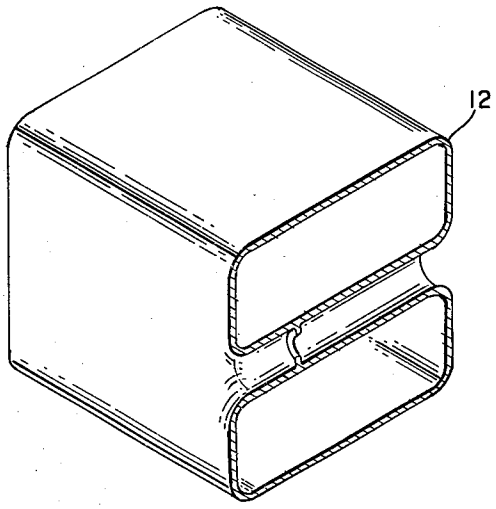


Fig. 8

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MISSILE LAUNCHING APPARATUS

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7 Claims. (Cl. 89—1.7)
(Granted under Title 35, U.S. Code (1952), sec. 266)

The invention described herein may be manufactured and used by or for the Government of the United States of America for governmental purposes without the payment of any royalties thereon or therefor.

The present invention relates to the launching of a missile or rocket vehicle from the ocean or other body of water.

Considerable attention has recently been given to the launching of missiles at sea. One reason why such a procedure has become of greater importance is that it eliminates the necessity of constructing extensive land-based facilities the cost of which is extremely high. Furthermore, such "hard" launching areas are more vulnerable to enemy countermeasures then are water-based sites, since the location of the latter may be changed at will by towing or otherwise moving the missile for any desired distance. Still further, there is greater safety in a water-launched operation, inasmuch as any malfunction of the missile will normally be absorbed by the surrounding fluid, eliminating or materially reducing the possibility of injury to personnel or destruction of the launching equipment.

One requirement inherent in the launching of a missile or rocket vehicle from a body of water is that the missile must be initially oriented in a upright position, and furthermore must remain relatively stable in spite of a tendency toward rolling and dipping which would ordinarily be imparted thereto by wave action. The basic stability of a missile in such an environment depends largely upon its size, shape, center of gravity, and the amount of its buoyancy. The latter, under most circumstances, is insufficient to bring the nose position of the missile above the surface, and hence it has been found necessary to supplement the amount of buoyancy which the missile fundamentally incorporates.

One solution to the above problem is set forth in U.S. Patent 3,077,143 issued February 12, 1963 to Draim et al. These patentees propose augmenting the original buoyancy of the missile at a point above its center of gravity, so that the final assembly will have a positive metacentric height—that is, the final center of buoyancy of the overall unit will be in closer proximity to the nose portion of the missile than is the final center of gravity.

In one embodiment of the invention set forth in the above-mentioned Drain et al. patent, this supplemental buoyancy for the missile is in the form of a ring-shaped floatation member freely encircling the missile in its upright position and upon which the latter rests through a plurality of radially-extending supports. This assembly yields increased stability under ordinary weather and water conditions due to the transverse distribution of the buoyant material with respect to the longitudinal axis of the missile. When the missile is launched, the supports merely cease to rest on the floatation member while the missile rises through the ring-shaped opening therein.

In a further United States Patent No. 3,093,033 issued June 11, 1963 to Drain et al. a further solution to the above problem is presented. These patentees recognize that it is desirable for any supplemental buoyant material that is added to a missile under the conditions being described should not remain in proximity to the missile after the initial phase of the launching operation has been completed. In other words, it has been found that certain hazards exist when these supplemental buoyant members remain close to the missile body where they might contact or become entangled in the missile fins or other outwardly-extending projections. To eliminate such a possibility, the disclosure of the last-mentioned patent provides for the forcible ejection of such material, a preferred method of so doing including the provision of one or more explosive charges embedded in or underlying the buoyant material, the latter being designed in the form of strips or sections which surround the upper portion of the missile in the manner of a jacket. When the explosive charges are ignited, the buoyant strips or sections of the jacket are forced radially outwardly and away from the vehicle for a sufficient distance so that no subsequent contact with the missile fins can occur. Such a jettisoning system necessitates the use of a considerable amount of explosive material in order to eject the buoyant members out of the immediate vicinity of the missile.

Although the respective devices of the above-mentioned patents perform their functions in the manner intended, nevertheless they require components, carried by the missile itself, which possess enough power to eject the buoyant members for a considerable distance. In other words, the radial propelling force for the floatation means is generated on or near the outer surface of the missile and acts upon the inner surface of the buoyant members. An important point to be considered in this connection is that the floatation means per se, while possessing buoyant qualities, is inert in the sense that any radial movement thereof with respect to the missile body is produced by forces exterior thereto, or, in other words, by a separate and distinct component or mechanism.

The herein-disclosed concept, while incorporating certain physical similarities to the structures set forth in the above-mentioned patents, nevertheless embodies a different principle of operation in that the buoyant means does not depend for its ejecting force upon any exterior apparatus, but instead contains therewithin the power to propel itself from the missile in the same manner as the structures of the prior art discussed above. In other words, this ability is latent in the buoyant means, and is only utilized when it is desired that such means be separated from the missile during a launching operation. In a preferred embodiment of the invention, a plurality of detachable buoyant chambers are disposed about the periphery of the missile or rocket just aft of the nose portion thereof. These buoyant chambers have walls which are composed of some flexible air- and water-tight material, such, for example, as nylon fabric impregnated with neoprene. These chambers are inflatable by any suitable means, and, when so inflated, are compressed or forced against the outer surface of the missile so that the normal shape or configuration of each chamber is distorted in the sense that it is flattened against the missile surface. Each chamber is secured before inflation either to a projection on the missile, or, alternatively to a rode or shaft which extends into an opening in the missile skin to some retaining device which can be released during a missile launch to allow the rod or shaft to disengage therefrom. When such disengagement of the rod or shaft connected to each buoyant member takes place, a radial momentum is developed by the buoyant chamber when it assumes its normal shape after being compressed against the missile surface in the manner above set forth. This is such as to result in an ejection of the buoyant chamber radially outwardly, and, if the original compression of the buoyant chamber was sufficient, then the ejecting force will carry the buoyant chamber for a considerable distance from the missile and prevent any entanglement of the buoyant means with the missile fins or other protuberances.

One object of the present invention, therefore, is to provide apparatus designed for use in launching a missile or other vehicle from a body of water.

Another object of the invention is to provide floatation apparatus which is designed for use with a water-launched missile or rocket, and which includes means whereby such apparatus may be quickly released from the missile when the initial phase of the launching operation has been completed.

A further object of the invention is to provide plurality of inflatable buoyant chambers intended to encircle the periphery of a water-launched missile and to be compressed against the missile's outer surface while the latter is being supported in launching position, such buoyant chambers being designed to be released from engagement with the missile when the latter leaves the water and to eject themselves radially outwardly to a location where they are free from possible entanglement with the missile structure, such radial ejection occuring due to the release of the compressive force between the buoyant member and the missile surface.

Other objects, advantages, and novel features of the invention will become apparent from the following detailed description of the invention when considered in conjunction with the accompanying drawings wherein:

FIGURE 1 is a perspective view of a missile being supported in a body of water by a plurality of buoyant members designed in accordance with a preferred embodiment of the present invention;

FIG. 2 is a partially sectional view of one of the buoyant members shown in FIG. 1, such member being illustrated following inflation but without any compression thereof;

FIG. 3 is a cross-sectional view, partially broken away, of the assembly of FIG. 1 taken along the line 3—3;

FIG. 4 is a partially sectional view of a portion of FIG. 3 taken along the line 4—4;

FIG. 5 is a further view of the assembly of FIG. 1, showing the manner in which the floatation means separates from the missile following the initial phase of the launching operation;

FIG. 6 illustrates a modification of one of the buoyant members shown in FIGS. 1, 2 and 3, in which a flexible chain or cable is utilized in placing of a rigid retaining rod; and

FIGS. 7 and 8 illustrate examples of the manner in which the configuration of each buoyant member of FIGS. 1, 2 and 5 may be modified without departing from the inventive concept.

Referring now to FIG. 1 of the drawings, there is shown a missile or rocket, generally identified by the reference numeral **10**, which is designed to be launched from a body of water. The vehicle **10** is assumed to have a specific gravity which is greater than the water which it displaces. Consequently, the vehicle **10** would not normally remain upright, and would sink into the water without assuming any particular orientation, rendering an effective launching thereof difficult or impossible.

The disclosure of Patent No. 3,077,143 discussed above teaches the provision of an impervious buoyant jacket to the missile above its original center of gravity, and so positioned as to locate the final center of buoyancy between the final center of gravity and the nose of the missile, whereby the latter erects itself vertically in an upward position with respect to the surface of the water. In this patent, the buoyancy means is in the form of a jacket divided into a plurality of strips longitudinally aligned with the missile. Associated with these jacket strips are a number of explosive squibs, which, when energized, act to cast off the buoyant elements in a direction transverse to the longitudinal axis of the missile.

Other expedients which have been employed in launching a vehicle of the type in question include a number of styrofoam blocks which are strapped around the missile or rocket just aft of the nose portion thereof. These

blocks engage protrusions on the missile body which prevent the missile from sliding down through the blocks. These protrusions were slanted to form cammed surfaces which act to impart a radial motion to the styrofoam blocks when the missile accelerated upwardly through them during the launching. These blocks are released when the missile begins to accelerate by means of explosive cutters on the straps by means of which the blocks are secured in position. A still further development along this same line retained the styrofoam blocks, but employed a plurality of springs under compression to propel or eject the blocks from the immediate vicinity of the missile.

In each of the methods above mentioned, the radial ejecting force by means of which the buoyant members were caused to leave the immediate vicinity of the missile was produced by means exterior to the buoyant members themselves. In other words, it was necessary to make use of some force-generating means or mechanism carried on the missile and preferably located between the missile's outer surface and the inner surface of the buoyant member. While operation of such an assembly was satisfactory in practice, nevertheless the additional force-producing components necessarily added both to the weight and complexity of the vehicle and increased the possibility of injury to personnel.

In accordance with a preferred embodiment of the present invention, the force necessary to bring about an ejection of each buoyant member **12** is incorporated into the member as an inherent characteristic thereof. No supplementary structure is required, thereby reducing the possibility of a malfunction which could result from contact between the buoyant members and the missile fins. A preferred apparatus for carrying out the present concept is through the utilization of a number of detachable buoyant chambers **12** disposed about the periphery of the vehicle **10** in the manner illustrated in FIGURE 1 of the drawings. Each of these buoyant chambers **12** is in the form of an inflatable air- and water-tight bag of toroidal configuration, preferably though not necessarily defining in cross-section a surface of revolution. The number of such members utilized depends largely upon the size and weight of the missile to be launched, and such number is chosen so that when the bags are disposed about the periphery of the missile, as shown in FIGURE 1, each buoyant member may contact the surface of the member lying to either side thereof. The bags **12** may, for example, be made of nylon fabric impregnated with neoprene.

Each of the buoyant members **12** of FIGURE 1 is provided with an opening **14** therethrough (as shown in FIG. 2) which is of sufficient diameter to accommodate entry of a rod **16**, one end of each rod carrying thereon a radially-enlarged retaining member **18** which, as again best shown in FIGURE 2, is provided with an annular groove **20** designed to receive therewithin an annular shoulder **22** which forms part of the inner wall of the bag opening **14**. The retaining member **18** is intended to receive therewithin the shoulder **22** of the buoyant member **12** not only when the latter is inflated, as shown in FIGURE 2, but also to hold this position prior to such time.

The remaining end of each rod **16** is provided with an annular groove **24** which is intended to be engaged by the upper and lower sections of a quick-release assembly, generally identified by the reference numeral **26**, shown in FIG. 3 and which will be more fully described in connection with FIGURE 4. At the present point, however, it need only be mentioned that each of the inwardly-extending rods **16** terminate near the longitudinal axis **28** of missile **10** in a manner best brought out by FIGURE 3. Each of these rods **16** is slidably carried within a tube **30** which also extends radially inwardly from the shell **32** of missile **10** and which are preferably attached to the inner surface of the shell by some method such as

welding, the shell **32** being of course provided with openings **33** through which the rods **16** extend.

In order to place the apparatus of the present invention in operating condition, or, in other words, to cause the same to act as a buoyant device for the missile **10**, each of the rods **16** is secured to its respective buoyant member, in which secure position the annular shoulder **22** is seated within the annular recess **20** of the retaining member **18**. Thus the rod **16** is precluded from moving axially with respect to the member **12**. With each member **12** in its deflated condition, the rods **16** are inserted in their respective tubes **30** to bring each set of oppositely-disposed rods to a position where the inner ends thereof are in proximity to one another, as best shown in FIGURE 4. The rods **16** are then maintained in this position during the initial phase of the launching operation by a quick-release device **26**.

This device **26** comprises a two-part housing (FIG. 4) the upper portion **34** of which is cup-shaped and provided with an outer tapered flange **36** which extends downwardly, as shown in the drawing. The lower portion **38** of the housing is similarly provided with an upwardly-extending tapered flange **40** of the same form as flange **36** and designed to engage the latter, except that four circular openings **42** are equally spaced apart in the plane defined by the mating flanges **36** and **40** as best shown in FIGURE 3.

Each annular groove **24** of the rods **16** is intended to be received within one of the openings **42**, so that the mating portions of the flanges **36** and **40** lie within each groove **24** and thus preclude any axial movement of the rods **16** radially of the missile's longitudinal axis **28** as long as the rods **16** are engaged by the housing flanges **36** and **40** in the manner illustrated in FIGURES 3 and 4.

With the assembly in the condition described above, each of the buoyant members **12** is inflated through a valve **43**. This causes the members to assume a configuration as shown in FIGURE 1, in which a portion of the surface of each bag is compressed against the outer skin of the missile **10** in the manner shown by FIGURE 3. The normal configuration of the bag (as shown by FIGURE 2) is distorted due to this compression, which flattens a portion of the bag surface in the manner illustrated by FIGURE 3.

When it is desired to rid the missile **12** of its floatation means upon completion of the initial phase of the launching operation, the rods **16** are each disengaged from the assembly **26** by which they were secured. This securing means comprises an explosive bolt **44** which may be of a more or less conventional design) and which is provided with a central portion **46** of reduced diameter. This central portion **46** of the bolt **44** lies intermediate the two portions **34** and **38** which make up the quick-release housing. On each side of the central portion **46** of the bolt **44** is embodied an explosive squib **48**, only one of which is shown in the drawing. These squibs **48** are intended to be energized by current supplied thereto over conductors **50**. However, the means for so energizing the squibs **48** forms no part of the present invention, and hence has not been illustrated in the drawing. The bolt **44** is held in position relative to the housing sections **34** and **38** by a plurality of nuts **52**.

Following the initial phase of the launching operation, the buoyant members **12** are no longer needed and it is desired to rid the missile **10** thereof. To accomplish this objective, a control current is transmitted over the conductors **50** to detonate the squibs **48**. This explosive action separates the two portions of the bolt **44** in the region **46** where the diameter of the bolt is reduced. When this occurs, there is no longer any means holding together the two portions **34** and **38** of the quick-release device **26**, and hence these portions also separate. The rods **16** are now free to slide within their respective tubes **30**, and such a radial outward movement thereof takes place due to the release of the compressive force previously established between each inflated bag **12** and the outer surface of the missile **10**. This force is sufficient to cause an ejection, or outward displacement, of each member **12** away from the immediate vicinity of the missile, as clearly illustrated in FIGURE 5 of the drawings. It should be recognized that the ejection of each bag **12** from the missile **10** as shown in FIGURE 5 occurs solely due to the expansion of each bag from its compressed state, and not as a result of any exterior force being applied thereto.

FIGURE 6 shows a modification of the buoyant device of FIGURES 1, 2, 3 and 5 in that each rigid rod **16** of the latter figures is replaced by flexible cable **54**, which in some cases facilitates the mounting of the bags **12** around the periphery of the missile **10** prior to inflation thereof. Although not shown in the drawings, the inner end of each cable **54** is provided with means for securing the cable to some form of quick-release mechanism similar to that of FIGURES 3 and 4.

In FIGURES 7 and 8 are illustrated alternative forms for each buoyant member **12**. It is only necessary that each buoyant object empolyed in practicing the present invention be composed of flexible airtight and watertight material which is sufficiently strong to support the object being floated and also capable of having attached thereto some means for securing the inflated member to the vehicle during the time that floatation of the latter is desired. For example, one particular arrangement which has been found to yield satisfactory results includes a spherical bag 5½ feet in diameter and with a central aperture 4 inches in diameter. The material of which the bag is composed consists of nylon impregnated with neoprene. The retaining rod utilized in connection therewith is a steel tube two inches in diameter and with a hub composed of aluminum.

With respect to those expedients which have been previously employed to accomplish the intended purpose, the present concept has been found to possess a number of important advantages. These include: (1) positive dispersion and disengagement of the floatation means independently of the initial acceleration of the missile or rocket, (2) an increased saftey factor with respect to spring-propelled rigid floats in the vent of a malfunction resulting in premature release, (3) the buoyant means of the present disclosure can readily be handled because of its light weight and lack of bulk when deflated, (4) the ejecting force is evenly distributed over a large area of the missile skin, (5) a floating missile is provided with a buffer against contact with boats, rafts, etc., and (6) the buoyant members may be deflated, attached to a sunken vehicle under water, and then reinflated to bring such sunken vehicle to the surface.

Obviously many modifications and variations of the present invention are possible in the light of the above teachings. It is therefore to be understood that within the scope of the appended claims the invention may be practiced otherwise than as specifically described.

I claim:

1. Apparatus designed for association with a missile having a nose portion and an exhaust region, said missile being launchable into the atmosphere from a body of water, said missile normally possessing insufficient inherent buoyancy to remain upright at or near the surface of such body of water in a position suitable for launching, wherein the longitudinal axis thereof is essentially perpendicular to the water surface, said apparatus comprising:

a plurality of flexible buoyant chambers of generally spherical configuration disposed to encircle said missile between its center of gravity and the nose portion thereof;

means for securing each of said buoyant chambers to said missile so that each such chamber contacts the missile's outer surface and is forcefully compressed thereagainst;

and means for releasing each of said buoyant chambers

from said missile so that they are no longer secured thereto;

whereupon the compression of each of said chambers is terminated, and the force developed as a result of such termination acts against the outer surface of the missile to propel each of the buoyant chambers in a radial direction with respect to the missile's longitudinal axis, so that, following such ejection, the said buoyant chambers are beyond the region within which subsequent engagement with the missile is likely to occur.

2. The combination of claim 1, in which each of the said buoyant chambers is in the form of an air- and water-tight bag which is inflated subsequent to its engagement with said missile, such inflation acting to develop a compression between each said bag and the outer surface of said missile;

each of said air- and water-tight bags being secured to said missile by an elongated retaining member one end of which is attached to said bag and the other end of which releasably engages said missile.

3. The combination of claim 2, in which said retaining member is in the form of a solid rod.

4. The combination of claim 2, in which said retaining member is in the form of a flexible cable.

5. The combination of claim 2, in which each of said buoyant chambers is essentially toroidal in shape, with the said retaining member being attached to the toroid within the reentrant portion thereof.

6. Floatation apparatus for a missile intended to be launched into the air from a body of water, said apparatus being designed to maintain the missile in an upright position wherein it is suitably oriented for launching, said floatation apparatus comprising:

a plurality of inflatable chambers disposed around the periphery of the missile in the region of its nose end;

means for releasably securing each of said chambers in a common region on said missile;

whereupon inflation of each of said chambers subsequent to their attachment to said missile will act to compress each of said chambers against the outer surface of the missile and result in a distortion of the normal inflated configuration of each chamber;

and means for simultaneously releasing said securing means for each of said chambers, thereby permitting each of said chambers to assume its normally inflated configuration;

the assumpition of such normal inflated configuration by each of said chambers producing a propulsive force for such chamber against the outer surface of the missile, said force being in such a direction as to cause dispersion of the buoyant chambers away from the immediate vicinity of the missile.

7. The combination of claim 6 in which each of the buoyant chambers, when inflated, defines a surface of revolution.

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