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AN ASSEMBLY FOR SELF-PROPELLED MOVEMENT
FROM A RELEASE POSITION BENEATH A WATER SURFACE

TO ALL WHOM IT MAY CONCERN:

BE IT KNOWN THAT (1) MICHAEL T. ANSAY, and (2) JOHN R. LITTLE, citizens of the United States of America, employees of the United States Government, and residents of (1) Johnston, County of Providence, State of Rhode Island, and (2) Swansea, County of Bristol, Commonwealth of Massachusetts, have invented certain new and useful improvements entitled as set forth above, of which the following is a specification.

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DISTRIBUTION STATEMENT A
Approved for Public Release
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AN ASSEMBLY FOR SELF-PROPELLED MOVEMENT
FROM A RELEASE POSITION BENEATH A WATER SURFACE

STATEMENT OF GOVERNMENT INTEREST
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.

BACKGROUND OF THE INVENTION
(1) Field of the Invention
The invention relates to the launch of bodies from
submarines at various depths, and is directed more particularly
to the launch of bodies, such as weapons, vehicles, and the like,
from locations outside the pressure hulls of the submarines.

(2) Description of the Prior Art
The United States Navy has expressed a need to carry greater
payloads of weapons/vehicles on submarines and a need to launch
weapons/vehicles from modular, external, payload bays.
Traditionally, such bodies have been stowed inside submarine
torpedo rooms, protected from the pressure and corrosiveness of
the ocean environment, and then launched from the submarine
torpedo tubes when needed.
A vertical air bag launcher has been considered as one method for launching a body externally, without the need for a traditional torpedo room. However, a primary concern with using air bags underwater is the large variation in submarine operating depths. Because of the large variations in depth pressure, a normal air bag inflator is unable to consistently fill an air bag to the same volume. An air bag inflator that produces a given amount of pressurized gas will fill a relatively small volume at deep depth pressures and a relatively large volume at shallow depth pressures. As a result, the air bag buoyant lift force will be much less when deployed at deep depths than at shallow depths.

If an air bag inflator is sized for the greatest expected depth pressure, it will rupture the bag when deployed at a shallow depth. If it is sized for a very shallow depth, it will not fill the air bag to the proper volume, or it may not deploy, at deep depths. In order to use air bags to launch weapons underwater, the air bag launcher must be able to compensate for all submarine operating depths.

There is thus a need for an air bag launch system in which the air bag is filled to a proper volume at all operating depths.

SUMMARY OF THE INVENTION

An object of the invention is, therefore, to provide an air bag launch assembly in which the air bag is filled to a volume
sufficient to provide ascent of the bag and a body connected
thereto, and which is adapted to adjust the pressure therein as
the assembly ascends toward the surface so as to provide the
required buoyancy while not permitting the bag to expand beyond
its limits.

With the above and other objects in view, a feature of the
present invention is the provision of an assembly for self-
propelled movement from a release position beneath a water
surface to a second position closer to the water surface. The
assembly includes a body whose function includes moving from the
release position to the second position, an air bag connected to
the body, a differential pressure relief valve in communication
with the air bag, and an air source in communication with the air
bag. The air source is adapted to provide air to the air bag to
inflate the air bag to lift the body toward the second position,
and the pressure relief valve is operative to maintain a selected
pressure differential in the air bag relative to outside water
pressure.

The above and other features of the invention, including
various novel details of construction and combinations of parts,
will now be more particularly described with reference to the
accompanying drawings and pointed out in the claims. It will be
understood that the particular assembly embodying the invention
is shown by way of illustration only and not as a limitation of
the invention. The principles and features of this invention may
be employed in various and numerous embodiments without departing from the scope of the invention.

BRIEF DESCRIPTION OF THE DRAWINGS
Reference is made to the accompanying drawings in which is shown an illustrative embodiment of the invention, from which its novel features and advantages will be apparent, and wherein:
FIG. 1 is a diagrammatic side elevational view of one form of assembly illustrative of an embodiment of the invention; and
FIG. 2 is a generally sectional view of a portion of the assembly of FIG. 1.

DESCRIPTION OF THE PREFERRED EMBODIMENTS
Referring to FIGS. 1 and 2, it will be seen that the assembly includes an air bag 10 of a material that is compatible with seawater and strong enough to support the weight, in water, of a selected weapon, canister containing a weapon, or other body 12.

The assembly further includes a housing 14 fixed to the air bag 10. The housing 14 is provided with one or more differential pressure relief valves 16 which serve to maintain a selected differential pressure between the air inside the air bag 10 and the water pressure outside the air bag.
Preferably, a gas generator 18 is disposed in the housing 14. The housing 14 is provided with a supply conduit 20 which conveys gas, typically air, to the air bag 10.

The air bag 10 is of a material that is flexible enough to be collapsed into a small volume but strong enough to support the weight, in water, of the weapon and canister it is intended to lift. The volume of the air bag 10 is sized to provide a buoyant lift force that sufficiently exceeds the weight of the weapon, housing, and any other resistive weight or force that could prevent ascension of the assembly. The air bag thickness is selected by the amount of differential air pressure it is designed to contain. The air bag is also able to endure the corrosiveness and other operating conditions in the ocean environment.

The air bag inflator preferably comprises the small gas generator 18. The gas generator 18 can be similar to any commercially available gas generator such as those utilized to inflate automobile air bags. The air bag inflater can also be a compressed gas cylinder as is well known in the art. It is sized to produce a sufficient amount of gas to fill the air bag at the greatest operating depth of the submarine. The air bag volume remains the same at all depths, but the pressure inside the air bag varies as a function of depth. At deep depths the air bag contains high pressure, while at shallow depths it contains low pressure. Thus, the gas generator 18 is sized to fill the air
bag 10 to the desired volume at the deepest operating depth of
the submarine. Any excess gas produced by the air bag inflator
is vented outside into the ocean environment via the pressure
relief valve mechanism 16.

The air bag inflator, i.e., the gas generator 18, is
triggered when a launch is desired. An electrical signal is used
to start the gas generator. Once operation of the gas generator
is initiated, the air bag begins to fill. When the air bag
reaches a volume large enough to produce a sufficient buoyant
lift force, the weapon/vehicle and canister, if present, are
lifted away from the submarine.

The gas generator 18 always produces the same amount of gas,
even though a different quantity is required for each depth. At
the deepest anticipated launch depth, the gas generator produces
enough gas to just fill the air bag or slightly overfill it. At
more shallow depths the air bag inflator will produce more gas
than necessary. To ensure that the air bag is not over inflated,
the excess gas is released by the pressure relief valve mechanism
16.

The pressure relief valve mechanism incorporates at least
one pressure relief valve 16 (FIG. 2) that is sized to maintain a
specific differential pressure inside and outside the air bag.
Pressure relief valve 16 is positioned in an outlet passageway 21
in the housing 14. One side 22 of the relief valve 16 is exposed
to sea pressure and the other side 24 is exposed to the internal
air bag pressure. Once the air bag pressure exceeds the outside
sea pressure by the desired differential pressure, the relief
valve 16 will lift off its seat and discharge the excess gas
pressure into the ocean environment.

The air bag inflator 18 provides for a constant lift force
at all depths. This is ensured by the pressure compensation
mechanism 16 that inflates the air bag to the same volume at all
launch depths. As a result, the launch performance is consistent
as a function of depth. Other weapon launch systems require
depth pressure equalization before a launch to ensure consistent
performance. The underwater air bag launch described herein is
depth pressure independent so it does not require depth pressure
equalization prior to launch. Therefore, the underwater air bag
launcher provides consistent launch performance at all depths and
does not require pre-launch depth pressure equalization.

The underwater air bag launch assembly can be sized easily
to accommodate various weapon/vehicle sizes. This is
accomplished by simply adjusting the size of the air bag and the
amount of fuel in the gas generator. In the same manner, the
underwater air bag launcher can be sized to provide various
launch performances as well.

As is understood from the above, the underwater air bag
launch assembly is defined by only a few components, which
translates into increased reliability and reduced maintenance.
Inasmuch as the underwater air bag launch assembly has few moving
parts, the wearing of parts over time is not a concern. Air bag
inflators have demonstrated such reliability that they are used
in millions of automobiles for personnel safety. The other
components that make up the air bag vertical launch system are
also well understood and known to be reliable.

The underwater air bag launcher can be used as a safety
device for submarines or submersible vehicles. Underwater air
bags can be attached externally to submarine hulls and designed
to employ before the submarine sinks to an unsafe crush depth.
Once deployed, the added buoyant force can be used to help ascend
the submarine back to a safe depth. The system herein described
can also be used to retrieve missiles which are used for test
purposes and are often lost in the oceans.

FIG. 2 shows the air bag attached to the top of the housing
having a gas generator 18 therein. However, the gas generator
may be remotely located, as opposed to being part of the air bag
assembly, by piping the gas from the gas generator to the air bag
(not shown).

There is thus provided an air bag launch assembly in which
the air bag pressure is initially limited to that which is
required to lift the assembly and its payload, and in which the
air bag pressure is thereafter regulated during ascent to provide
the required buoyancy while not permitting the bag to expand
beyond its limits.
It will be understood that many additional changes in the
details, materials, steps and arrangement of parts, which have
been herein described and illustrated in order to explain the
nature of the invention, may be made by those skilled in the art
within the principles and scope of the invention as expressed in
the appended claims.
AN ASSEMBLY FOR SELF-PROPELLED MOVEMENT
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ABSTRACT OF THE DISCLOSURE

An assembly for generating buoyancy for an attached self-propelled body for movement from a release position beneath a water surface to a second position closer to the water surface includes an air bag connected to the body, a differential pressure relief valve in communication with the air bag, and a gas source in communication with the air bag. The source provides gas to the air bag to inflate the air bag to lift the body toward the second position, and the pressure relief valve is operative to maintain a selected pressure differential in the air bag relative to outside water pressure.