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3 APPENDED POD UNDERWATER GUN MOUNT

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5 STATEMENT OF GOVERNMENT INTEREST

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

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11 BACKGROUND OF THE INVENTION

12 (1) Field of the Invention

13 This invention generally relates to an appended
14 underwater gun mount. More particularly, the invention
15 relates to an appended underwater gun mount for both mounting
16 and controlling an underwater gun so as to be able to engage
17 and destroy attacking torpedoes.

18 (2) Description of the Prior Art

19 The current art for anti-torpedo devices is under
20 investigation by Naval engineers in several countries who are
21 investigating the technical and operational problems
22 associated with torpedo defense. Efforts to defend ships and
23 submarines against attacking torpedoes have resulted in a
24 number of concepts for inclusion within shipboard Torpedo
25 Defense Systems (TDS). Those concepts include sensors for
26 detecting the sound of an incoming torpedo, development of

1 recommended evasive maneuvers to avoid such a weapon,
2 deployment of countermeasures to decoy the torpedo, and anti-
3 torpedo weapons to destroy it before it strikes its intended
4 target. Anti-torpedo weapons that are being investigated or
5 developed include guns that are capable of firing underwater.

6 Typically, these are medium caliber, projectile firing guns
7 that can launch a stream of bullet-like objects at a very high
8 velocity in rapid sequence. Such guns are envisioned as being
9 used underwater against attacking torpedoes in a manner
10 similar to anti-air missile systems such as the PHALANX close
11 in weapons system (CIWS) against incoming airborne missiles.

12 The concept of using an underwater "machine gun" to
13 destroy an attacking torpedo is appealing because it provides
14 a positive and conclusive defensive response to such a
15 situation. If the direction, or bearing, of an incoming
16 torpedo is determined by a sensor on board a targeted vessel,
17 requisite response action is to aim the gun and direct the
18 release of its projectiles towards the threat. That process,
19 however, is a complex function, composed of the combination of
20 inter-related launcher, fire control, and operability issues
21 that are all technically challenging. The first is the
22 problem of providing a suitable launcher, or mounting
23 apparatus, for containment of the gun and its ammunition. The
24 gun mount must be capable of being controlled or moved into a
25 position that will point the barrel of the gun towards an

26

1 attacking torpedo, in accordance with an appropriate fire
2 control solution.

3 Since projectiles fired from an underwater gun, or any
4 type of conventional gun, are not controllable after release,
5 the physical position of the gun barrel determines the
6 direction subsequently taken by the shot. Bullets shot from
7 guns are "unguided missiles", subject to ballistic influences
8 such as gravity, drag, and the like, after leaving the barrel.

9 Therefore, the gun mount must have sufficient flexibility of
10 movement to allow the muzzle of the gun to be pointed towards
11 any direction from which a torpedo attack is probable.

12 While a torpedo may strike any part of the hull of a
13 targeted vessel, it is generally considered that the area of
14 greatest danger from a modern torpedo is astern. One reason
15 is that the stern of a ship, or a submarine, is the location
16 of the screw(s) or propulsors that drive it through the water.

17 A great deal of energy (acoustic and other) is transferred
18 from the vessel to the surrounding medium at that location.
19 Modern torpedoes are designed to sense and seek such energy,
20 and thus, a homing torpedo is likely to attack from astern,
21 unless measures have been taken, and have been successful, to
22 eliminate that stimulus.

23 Another reason for expecting a torpedo attack from astern
24 is that a common tactic for any ship, if alerted to impending
25 danger, is to turn away from an incoming weapon. That is a
26 natural reaction, and it is logical to minimize the relative

1 velocity between a weapon and its target by attempting to
2 outrun it. Also, turning away from the torpedo presents a
3 much smaller aspect or cross section. Therefore, the ship's
4 own maneuvers may steer the danger area, intentionally, to the
5 stern.

6 Accordingly, a need in the art exists in which an anti-
7 torpedo gun must be able to deploy a field of fire that fills
8 a conical volume of space astern of a vessel that is host to
9 such a defensive system. An obvious problem with respect to
10 implementation of that capability is that the stern of a ship
11 is the location of control and propulsion mechanisms that
12 would be in the way of any hull mounted launcher aimed astern.

13 Location of a gun mount aft of those mechanisms is
14 impractical, because the stream of gunfire would issue
15 directly into the turbulence of the ship's wake. A gun mount
16 configured as a towed body would also be impractical, because
17 the precise location and attitude of the module would be
18 variable and uncertain, and deployment would be difficult.

19 Accordingly, it is the inventor's discovery that the
20 functional capability that is needed to engage attacking
21 torpedoes is a hull mounted, controllable gun mount that can
22 fire past, or around, the screws and control surfaces of the
23 host vessel.

24 The following patents, for example, disclose various
25 types of anti-torpedo devices, but do not disclose a hull
26 mounted, controllable gun mount that can fire past, or around

1 the screws and control surfaces of the host vessel.

2 U.S. Patent No. 3,875,844 to Hicks;

3 U.S. Patent No. 4,215,630 to Hagelberg et al.;

4 U.S. Patent No. 4,855,961 to Jaffe et al; and

5 U.S. Patent No. 5,341,718 to Woodall, Jr. et al.

6 Specifically, the patent to Hicks discloses an anti-
7 torpedo system having, in combination, a radio frequency
8 bridge having a source of radio frequency power connected
9 thereto, a line of reference arranged at a predetermined
10 distance from the vessel and parallel thereto, said reference
11 line comprising an antenna disposed beneath and in contact
12 with the water and abeam the vessel, means for applying a
13 radio frequency current from said source to the antenna, the
14 ends of one of the arms of said bridge being connected to the
15 hull of the vessel and to said antenna respectively, said one
16 arm including an electrically conductive path through the
17 water between the antenna and said hull, means in at least one
18 of the other arms for initially adjusting the bridge to an off
19 balance condition, an output circuit for said bridge, a
20 transformer in said output circuit, detector means operatively
21 connected to the output of said transformer, a discharge tube
22 having the control element thereof connected to the output of
23 said detector means, the degree of initial unbalance of said
24 bridge being insufficient to fire said tube, a plurality of
25 explosive missiles, a plurality of guns aimed just beneath
26 said line of reference for firing said missiles in the

1 direction of the torpedo, and electro-responsive firing means
2 on each of said guns operatively connected to the plate of
3 said tube for firing the guns when a torpedo has approached
4 said line of reference to a point substantially subjacent with
5 respect thereto and thereby changed the impedance of the
6 antenna circuit and the radio frequency current flowing
7 therein sufficiently to fire said tube.

1 The patent to Hagelberg et al. disclose a ship anti-
2 torpedo system including a detecting device for detecting and
3 locating an incoming threat, such as a torpedo, and an
4 interrelated missile launching and control system for firing
5 at least one warhead carrying missile into the path of the
6 oncoming threat, the missile having an active acoustic fuse
7 system including a highly directional sensing system for
8 continuously monitoring the position and proximity of the
9 incoming threat and for detonating the warhead at the optimum
10 proximity of the incoming threat with the missile. The
11 missile floats at a predetermined depth determined by the
12 predetermined depth of the torpedo to be intercepted.

13 Jaffe et al. disclose an imaging apparatus including an
14 array of transmitters for simultaneously transmitting more
15 than two coded signal beams in different directions to cover
16 different regions of a field of view, said beams being
17 modified by objects within said field of view, signal means
18 for providing individual coded signals to respective
19 transmitters, at least one receiver for simultaneously
20 receiving plural coded modified signals derived from the coded
21 signal beams, and a processor for separating the plural coded
22 modified signals of different codes and processing them into
23 an image signal.

24 Woodall, Jr. et al. disclose an acoustic decoy round
25 ejected by a launcher for flight above water from a sea-going
26 vessel, the round impacting at the water surface to cause

1 separation of a payload from a forward section of the round
2 that is also separated from a flotation anchor tethered to the
3 payload and fins which stabilize launched flight of the round
4 prior to impact. The separated payload submerges from the
5 flotation anchor at the water surface location to a tethered
6 depth within the water from which a decoy signal is emitted.

7 It should be understood that the present invention would
8 in fact enhance the functionality of the above patents by
9 providing a hull mounted, controllable gun mount that can fire
10 past, or around, the screws and control surfaces of the host
11 vessel so as to be able to engage and destroy attacking
12 torpedoes.

13

14

SUMMARY OF THE INVENTION

15 Therefore it is an object of this invention to provide a
16 hull mounted, controllable gun mount.

17 Another object of this invention is to provide a hull
18 mounted, controllable gun mount for engaging and destroying
19 attacking torpedoes.

20 Still another object of this invention is to provide a
21 hull mounted, controllable gun mount which directs an
22 unobstructed line of fire at objects, underwater, closing from
23 astern of a host vessel.

24 A still further object of the invention is to provide a
25 hull mounted, controllable gun mount which facilitates
26 converging gun fire from two controllable gun mounts.

1 Another object of the invention is to provide forward and
2 aft firing guns, co-located within the same gun mount.

3 Yet another object of this invention is to provide a hull
4 mounted, controllable gun mount which is simple to manufacture
5 and easy to use in any of a plurality of selected or necessary
6 environments.

7 In accordance with one aspect of this invention, there is
8 provided an appended pod underwater gun mount for a
9 submersible host vessel. The appended pod underwater gun
10 mount includes a strut member having a base end fixed to an
11 outer hull of the submersible host vessel and a distal end
12 protruding outwardly from the host vessel, the distal end
13 being angled with respect to the base end, and an ammunition
14 housing moveably fixed to the distal end of the strut member.

15 A train control mechanism is positioned between the strut
16 member and the ammunition housing for controlling the
17 horizontal rotation of the ammunition housing with respect to
18 the host vessel, and a tilt control mechanism is positioned
19 between the strut member and the ammunition housing for
20 controlling the vertical rotation of the ammunition housing
21 with respect to the host vessel. A flexible boot is connected
22 to the ammunition housing and surrounds each of the train
23 control mechanism and the tilt control mechanism to protect
24 the mechanisms from an underwater environment. The ammunition
25 housing is movable both vertically and horizontally with
26 respect to the distal end of the strut member and is spaced

1 apart from the host vessel so as to avoid contacting the host
2 vessel during directional movement of the ammunition housing.

3

4 BRIEF DESCRIPTION OF THE DRAWINGS

5 The appended claims particularly point out and distinctly
6 claim the subject matter of this invention. The various
7 objects, advantages and novel features of this invention will
8 be more fully apparent from a reading of the following
9 detailed description in conjunction with the accompanying
10 drawings in which like reference numerals refer to like parts,
11 and in which:

12 FIG. 1 is a side plan view of a first preferred
13 embodiment of the present invention showing a partial
14 submarine hull having an appended pod underwater gun mount
15 fixed thereto;

16 FIG. 2 is a cross sectional view taken along line 2-2 of
17 FIG. 1 showing appended gun mount locations;

18 FIG. 3 is an expanded and partial sectional view of an
19 appended pod gun mount according to the first preferred
20 embodiment of the present invention;

21 FIG. 4 is a detailed view of the appended pod underwater
22 gun mount according to the first preferred embodiment of the
23 present invention;

24 FIG. 5 is a top plan view illustrating a comprehensive
25 planar field of fire for a pair of appended pod underwater gun
26 mounts according to the present invention;

1 FIG. 6 is a side plan view illustrating a comprehensive
2 vertical field of fire for an appended pod underwater gun
3 mount according to the present invention;

4 FIG. 7 is a top plan view illustrating a further appended
5 pod underwater gun mount location and related field of fire
6 according to the present invention;

7 FIG. 8 is a typical surface ship implementation for a
8 deployed appended pod underwater gun mount according to a
9 second preferred embodiment of the present invention;

10 FIG. 9 is a top plan view illustrating a field of gunfire
11 achievable by a pair of appended pod underwater guns according
12 to the embodiment shown in FIG. 8;

13 FIG. 10 illustrates two applications of the appended pod
14 underwater mount according to the first preferred embodiment
15 of the present invention; and

16 FIG. 11 diagrammatically illustrates system integration
17 and operation of the appended pod underwater mount according
18 to the present invention.

19

20 DESCRIPTION OF THE PREFERRED EMBODIMENT

21 In general, the present invention is directed to the
22 mounting and control of an underwater gun so as to be able to
23 engage and destroy attacking torpedoes. Other applications,
24 including the use of the concept as a launcher for submarine
25 anti-aircraft ordnance, are intended.

26

1 Referring first to FIGS. 1 through 4, primary features of
2 a first preferred embodiment of the subject invention are
3 shown.

4 FIG. 1 is a side plan view of a portion of a submarine
5 hull 10 having a fore end 12 (not entirely shown) and an aft
6 end 14. A rudder 16 is vertically mounted with respect to an
7 upright orientation of the submarine and adjacent the aft end
8 14 of the submarine hull 10, and a screw 18 or other known
9 propulsion system is mounted at the aft end 14 of the
10 submarine hull 10 behind the rudder 16. Stern planes 20 are
11 horizontally mounted with respect to an upright orientation of
12 the submarine and such that the stern planes 20 are
13 perpendicular to the rudder 16.

14 At least one appended pod underwater gun mount 22,
15 encompassing the subject matter of the present invention, is
16 mounted to the submarine hull 10 in a position with respect
17 thereto as shown. The appended pod underwater gun mount 22
18 includes a fore end 22a and aft end 22b corresponding to the
19 fore and aft ends of the submarine hull 10.

20 FIG. 2 is a cross sectional view taken along lines 2-2 of
21 FIG. 1 and showing a stern view of the submarine hull 10 with
22 two appended underwater gun mounts 22 mounted thereto.

23 More specifically, in FIG. 2, the stern view of the
24 submarine hull 10 shows the location of two appended pod gun
25 mounts 22 located symmetrically at a radial distance from a
26 centerline 24 of the ship, and substantially greater than the

1 radius of the hull 10. The aft ends 22b of the pod mounts 22
2 thereby can be directed down as well as up and outwards
3 without interference from the ship's hull 10. At least one
4 gun 26 (described in further detail below) is located along a
5 longitudinal axis of each pod 22, and will be capable of
6 firing through a quadrant of space between rudders 16 and the
7 stern planes 20, and thus the critical zone of danger from
8 attacking torpedoes, astern of the submarine, can be defended
9 with a comprehensive field of gunfire.

10 Turning now to FIG. 3, there is shown an enlarged and
11 partial cross-sectional view of an appended pod underwater gun
12 mount 22 and major features thereof for connection to the hull
13 10 of the submarine. FIG. 4 is a side schematic view further
14 illustrating the components of the appended pod underwater gun
15 mount 22. The appended pod underwater gun mount 22 is
16 generally cylindrical in shape. The shape necessarily lends
17 itself to a streamlined and fluid dynamic outward surface. In
18 other applications, it is understood that the shape thereof
19 may vary. The cylindrical appended pod gun mount 22 is
20 controllable in train and elevation (tilt), similar to
21 traditional gun mounts or turrets, but it is unique because of
22 its form and the means by which it is joined to its host
23 vessel. The size of the cylindrical pod 22 will be dependent
24 on the specific number and types of weapons to be mounted
25 within it. However, a representative application may be

26

1 envisioned as a module about 20 feet in length and 3 feet in
2 diameter.

3 More specifically, the pod 22 is attached to the hull 10
4 of a submarine as an appendage or offset structure. Rather
5 than being attached directly to or through the hull 10 of the
6 submarine, as a traditional turret would be, the appended pod
7 22 is removed several feet away from the hull 10 where it
8 realizes the advantage of effectively being somewhat apart
9 from the ship, while actually being integral with it and its
10 travel. Thus, each appended pod gun mount 22 is attached to
11 the hull 10 of a submarine or the like by a strong horn or
12 strut 28 that extends outward and upward from the hull 10,
13 near the stern 14 but forward of the rudders 16 and stern
14 planes 20. The strut 28 is streamlined in cross section, as
15 is the pod assembly, to minimize hydrodynamic drag. The strut
16 28 emerges from the hull surface 10 in a radial direction, but
17 an outer end 30 thereof is bent upward so that a train control
18 mechanism 32 will operate to turn the pod 22 in a horizontal
19 plane and a tilt control mechanism 40 will operate to turn the
20 pod 22 about a vertical plane when the ship is level. That
21 is, a train axis 34 is at or nearly vertical and a tilt axis
22 36 is horizontal when the submarine is trimmed for operation
23 at any constant depth. The horizontal motion given by this
24 mechanism is identified as "train" in the language of naval
25 gun mounts and turrets, and therefore is used here for
26 consistency of terminology. On a submarine, a distance

1 between outboard sides of the two symmetrical appended pod gun
2 mounts 22 is kept slightly less than the beam of the ship at
3 that location, so as to avoid interference with any object
4 that is alongside of the vessel when in port.

5 The cylindrical pod 22 and its supporting tilt assembly
6 rest on a bearing surface 38 where there is a motor or similar
7 mechanism associated with the pod train control mechanism 32.

8 The tilt assembly including the tilt control mechanism 40
9 will direct the entire appended pod gun mount 22 to be rotated
10 clockwise or counterclockwise (in FIG. 4) in accordance with
11 remote control signals from within the host vessel.

12 The pod train control mechanism 32 is positioned below
13 the bearing surface 38. The amount of train may be limited by
14 a particular application, in order to minimize the flow
15 resistance presented by the side of the pod 22 that faces
16 forward when trained off centerline. For a torpedo defense
17 application, an angle of 30 degrees clockwise or
18 counterclockwise is likely to be adequate. In all applications,
19 it is intended that the pod mounts 22 be stabilized by fire
20 control orders that compensate for ship motion such as roll
21 and pitch.

22 Further, a flexible boot 42 surrounds the entirety of the
23 tilt axis 36, the pod tilt control mechanism 40 and the pod
24 train control mechanism 32. The flexible boot 42 or collar
25 encloses the space between the pod 22 and the tilt assembly 40
26 to form a streamlined outer configuration. The space inside

1 the flexible boot 42 or collar may be pressurized or free
2 flooding to maintain its flexibility at any depth.

3 Referring further to the detail shown in FIG. 4 the
4 appended pod 22 particularly includes forward 44 and aft 46
5 facing gun barrels, and at least one ammunition magazine 48,
6 within a cylindrical enclosure, tapered at each end to a
7 streamlined, spindle shape.

8 FIGS. 5 and 6 illustrate the advantage provided by the
9 appended pod gun mounts 22 in achieving a comprehensive field
10 of fire (denoted by dashed lines 22a) to engage torpedoes
11 approaching from astern. A pair of pods 22 can be mounted so
12 that the field of fire from each of the aft facing guns 26 or
13 gun barrels 46 overlaps the other, and it is thereby possible
14 to engage attacking torpedoes by converging streams of
15 projectiles that increase the overall defensive power of the
16 guns 26 or gun barrels 46. That is possible because of the
17 unique offset arrangement of the two mounts 22.

18 A secondary area of danger from attacking torpedoes is
19 from ahead of the targeted vessel. The threat of an impending
20 torpedo attack may be reduced by turning towards an incoming
21 weapon as well as away from it, because of reduced aspect.
22 Therefore, it is desirable that an anti-torpedo gun be able to
23 fire ahead at weapons approaching the bow, as well as astern.
24 The present invention succeeds in realizing that goal because
25 of the combination of the previously described offset mounting
26

1 and by the unique concept of having both forward 44 and aft
2 facing 46 gun barrels within the same pod mount 22.

3 FIG. 7 shows that each of the pod mounts 22 located near
4 the stern 14 of a submarine can also effect a field of fire
5 22a that is forward and to the outboard side of the ship. A
6 narrow area directly ahead of the ship remains to be guarded,
7 and the proposed solution is to mount a third pod 22' on the
8 centerline 24 of the forward end 12 of the submarine, directly
9 forward of a "sail" structure 50 and substantially aligned
10 with bow planes 52 of the vessel. Thereby, the area forward
11 of the submarine will be completely defended as shown by the
12 field of fire 22b of the third pod 22'.

13 A major advantage for the subject invention is that it
14 can be applied to the defense of both surface ships and
15 submarines. Accordingly, a typical surface ship
16 implementation is shown in FIG. 8. In the case of a surface
17 ship 54, it would not be practical to mount the pods 22
18 permanently and offset to the sides of the ship because they
19 would interfere with mooring the vessel in port.
20 Consequently, the preferred embodiment of the invention when
21 applied to a surface installation is to mount pods 22" on the
22 ends of extender arms 72, which function similar to the struts
23 28 on the submarine to hold the pods 22" at some distance away
24 from the hull 55 of the ship 54 and clear of the propellers
25 (not shown). The extender arms are configured so as to be
26 axially extendable and able to lift the pod mounts 22" out of

1 the water and on board the host vessel to a stowed position
2 (indicated by dashed outline 22c) when not needed. In order
3 to successfully maneuver the extender arms 72, a pivot member
4 74 is mounted on a deck 76 of the ship 54 and a base end 72a
5 of the extender arm 72 is connected thereto. Withdrawal of
6 the extender arm 72 and pod 22" results in a pivot of about
7 180 degrees to place in a stowed position 22c on the deck 76.
8 Stowage is contemplated to include a platform 78 attached to a
9 mast 80 mounted on the deck 76 of the ship 54. Any known
10 method of connecting to the platform 78 is considered to be
11 within the scope of the invention. Finally, manual or
12 automated actuation of the extender arms 72 is achieved
13 according to a preferred system of the vessel.

14 The field of gunfire that can be achieved by a pair of
15 appended pod underwater guns 22" for defense astern of a
16 surface ship is shown in the top plan view of FIG. 9 (dashed
17 lines 22d). Since the pods 22", when deployed, will be
18 positioned just a few feet below the surface of the water,
19 there will be little requirement for tilt except for some
20 downward angle. The surface problem is closer to being a two
21 dimensional situation than the submarine case, where torpedoes
22 may threaten from above as well as below the targeted vessel.
23 The surface pod mount installation shown in FIG. 9 will also
24 provide some degree of protection against torpedoes attacking
25 from forward, but a more practical and thorough defense ahead
26 would be realized by mounting another pair of extended pods on

1 either side of the surface ship near the bow. The use of a
2 single, third pod, on an extender arm (not shown) directly
3 forward of the bow is a possible alternative, but it would be
4 more difficult to implement because of the effect of ship
5 pitch motion which would tend to lift the pod out of the water
6 at times.

7 A significant advantage associated with the appended pod
8 gun mounts 22 is that in all of the installations described,
9 access to the mounts for arming and servicing can be done
10 above water. While the gun mounts are designed for tactical
11 use underwater, they are readily available in the open
12 environment to ship crews while in port or in transit. On a
13 submarine, they are fixed at positions well above the ship's
14 waterline when surfaced. On a surface ship, the pod mounts
15 are designed to be brought aboard for stowage and maintenance.
16 While intended for underwater use, the underwater pod mounts
17 do not have to endure the rigors of a constant underwater
18 environment.

19 The appended pod underwater gun mount 22 was inspired by
20 the primary need to engage torpedoes that attack a ship or
21 submarine from astern. A torpedo encounter may take place or
22 continue to a very short range, and it is essential that a
23 defensive stream of gunfire can be sustained, unhindered by
24 ship structures, as long as possible in that scenario. The
25 appended pod mount concept enables that functionality, but it
26 has further potential. In addition to torpedo defense, the

1 appended pod concept can be extended to support several other
2 useful applications.

3 FIG. 10 illustrates the use of an appended pod 22 as
4 either an underwater gun mount or missile launcher to support
5 submarine defense against aircraft 100 or small ships 102 at
6 close range. Such situations may be of particular concern if
7 a submarine is required to operate in shallow water. An
8 appended pod mount 22, in a position above the hull of a
9 submarine, can be trained and elevated to point in any
10 direction above the host vessel to deploy ordnance or other
11 devices. The pod mount 22 can serve as a self contained
12 magazine and launcher, with no passage requirement from within
13 the submarine except power and remote fire control signals.
14 Finally, the underwater pod mount 22 can be considered for use
15 as a storage and launching mechanism for other devices
16 deployed in the oceans. Included would be various types of
17 countermeasures, sonobuoys, and miscellaneous objects
18 requiring covert deployment.

19 FIG. 11 is provided to address the issues of system
20 integration and operation. Both will be influenced by the
21 particular application selected for the appended pod
22 underwater gun mount 22. A simplified system diagram is
23 provided, showing the appended pod underwater gun mount 22
24 used as part of a sub-system to an existing Torpedo Defense
25 System (TDS) 60 to provide the adjunct capability of anti-
26 torpedo gunfire. Operator control 58 is exercised via the

1 torpedo defense system 60. That is, a gunfire sub-system is
2 brought to ready status and ordered to respond to appropriate
3 detection and classification criteria by personnel in charge
4 of the overall torpedo defense functions. A fire control
5 computer 62 is shown for processing sensor information 56
6 regarding the torpedo's position, and developing launcher and
7 firing orders 64 that will aim and fire the weapon(s) in the
8 most effective manner. Included in those computations would
9 be the transfer of control from one gun to another, and the
10 coordination of more than one gun for simultaneous engagement.
11 In the example diagram, the appended pod underwater gun mount
12 fire control computer 62 is shown to be separate from the
13 torpedo defense system 60, but its functions could easily be
14 integrated within the TDS processors.

15 Interface signals between the fire control computer 62
16 and the appended pod 22 are similar to those of traditional
17 naval weapon systems. The position and status 68 of the
18 weapon and launcher, or appended pod 22, are fed back
19 continually to the fire control computer 62, while launcher
20 orders, including train and tilt data 66 and compensation data
21 70 for ship motion are transmitted to the launcher. Firing
22 orders 64 from the fire control computer 62 determine
23 actuation of the gun(s) in the appended pod underwater gun
24 mount 22.

25 Accordingly, the present invention provides a remote
26 controlled gun mount configured as a streamlined, hydrodynamic

1 compatible module, for use underwater. Further, the
2 underwater gun mount defined in this disclosure is unique in
3 that it is configured as an elongated streamlined pod, similar
4 in shape to a torpedo or a paravane, thereby presenting
5 minimum resistance to hydrodynamic flow when oriented in its
6 ready-for-action position, where the gun mount longitudinal
7 axis is held parallel to the direction of motion of the host
8 vessel. Traditional shipboard enclosed gun mounts are
9 typically configured as circular dome shaped structures or
10 rotating box forms. Further, the device of the present
11 invention enables the use of guns to direct an unobstructed
12 line of fire at objects, underwater, closing from astern of a
13 host vessel and the concept of mounting a fully controllable
14 gun mount offset from the hull of the host vessel is unique.
15 Guns located within such a mount will provide a clear line of
16 fire towards torpedoes attacking from astern. Because of the
17 offset mount configuration, ship screws, propulsors, control
18 surfaces, and the ship's wake will not obstruct defensive
19 ordnance launched in that critical direction.

20 Even further, since the preferred embodiment of this
21 invention provides two gun mount pods near the stern of the
22 host vessel, one on either side, it is possible to engage an
23 attacking torpedo with converging or intersecting streams of
24 gunfire, thereby increasing the probability of a successful
25 engagement. The invention enables simultaneous use of two gun
26 mounts against an advancing torpedo.

1 Because of the dual mount configuration, there is built-
2 in redundancy that will increase the availability of the TDS
3 to respond to a torpedo threat, despite possible system
4 casualty or degradation.

5 The streamlined pod housing of the gun mount facilitates
6 installation of both forward and aft firing weapons within the
7 same enclosure. Forward facing guns mounted in appended stern
8 pods can fire directly ahead and in an arc to the outboard
9 side of centerline ship structures such as the submarine
10 "sail". On a submarine, the narrow, undefended zone directly
11 ahead of the vessel can be eliminated by the option of
12 mounting a third pod forward of the "sail", which will result
13 in protection against an incoming torpedo by the combination
14 of as many as three underwater gun mounts (see Figure 7).

15 The invention is unusual in that it is applicable to both
16 submarines and to surface ships. In addition, the underwater
17 gun mount pods are accessible, above the water, for servicing,
18 when not deployed. In a submarine application, the pod mounts
19 are fixed structures that are above the ship's hull when
20 surfaced. In a surface ship installation, the pod mounts are
21 configured to be withdrawn to an on-board stowed position when
22 not required. Finally, the device is configurable as a remote
23 controlled external mount for containment and launch of anti-
24 air and anti-surface ordnance from submarines. As described
25 above, a viable alternative application of the underwater pod
26 mount is to support the deployment of gun fired projectiles or

1 small missiles against aircraft or surface craft operating
2 above a submerged submarine that is at shallow depth. Typical
3 targets would be anti-submarine helicopters, or surface craft
4 at ranges too close to be engaged with anti-ship torpedoes.
5 The pod mount could also be used to launch countermeasures,
6 sonobuoys, or other devices that need to be deployed
7 underwater from a ship or submarine.

8 The final configuration of the appended pod underwater
9 gun mount will depend upon the particular application for
10 which it is selected. A streamlined, hydrodynamic form is
11 specified, but the exact design of the pod to achieve maximum
12 compatibility with a ship or submarine of a specific class is
13 a function of engineering design associated with
14 implementation. Also, the design of the strut or extender arm
15 that holds it away from the host platform is subject to
16 refinement. It is acknowledged that variations in methods,
17 materials, and construction may be applied towards achievement
18 of the concepts disclosed herein, while maintaining the
19 functional qualities of the invention.

20 Accordingly, it is anticipated that the invention herein
21 will have far reaching applications other than those of
22 underwater or above water vehicles described, and any such
23 modification is intended to be included herein.

24 This invention has been disclosed in terms of certain
25 embodiments. It will be apparent that many modifications can
26 be made to the disclosed apparatus without departing from the

1 invention. Therefore, it is the intent .
2 to cover all such variations and modifications as come within
3 the true spirit and scope of this invention.

3 APPENDED POD UNDERWATER GUN MOUNT

5 ABSTRACT OF THE DISCLOSURE

6 An appended pod underwater gun mount for a submersible
7 host vessel includes a strut member having a base end fixed to
8 an outer hull of the submersible host vessel and a distal end
9 protruding outwardly from the host vessel, the distal end
10 being angled with respect to the base end, and an ammunition
11 housing moveably fixed to the distal end of the strut member.

12 A train control mechanism is positioned between the strut
13 member and the ammunition housing for controlling the
14 horizontal rotation of the ammunition housing with respect to
15 the host vessel, and a tilt control mechanism is positioned
16 between the strut member and the ammunition housing for
17 controlling the vertical rotation of the ammunition housing
18 with respect to the host vessel. A flexible boot is connected
19 to the ammunition housing and surrounds each of the train
20 control mechanism and the tilt control mechanism to protect
21 the mechanisms from an underwater environment. The ammunition
22 housing is movable both vertically and horizontally with
23 respect to the distal end of the strut member and is spaced
24 apart from the host vessel so as to avoid contacting the host
25 vessel during directional movement of the ammunition housing.

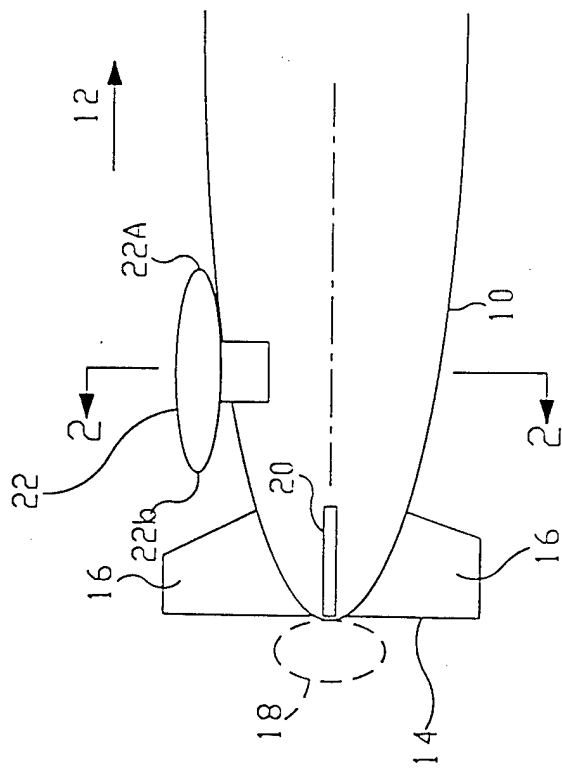


FIG. 1

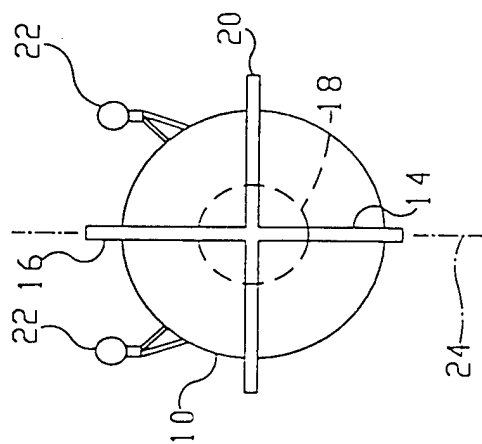


FIG. 2

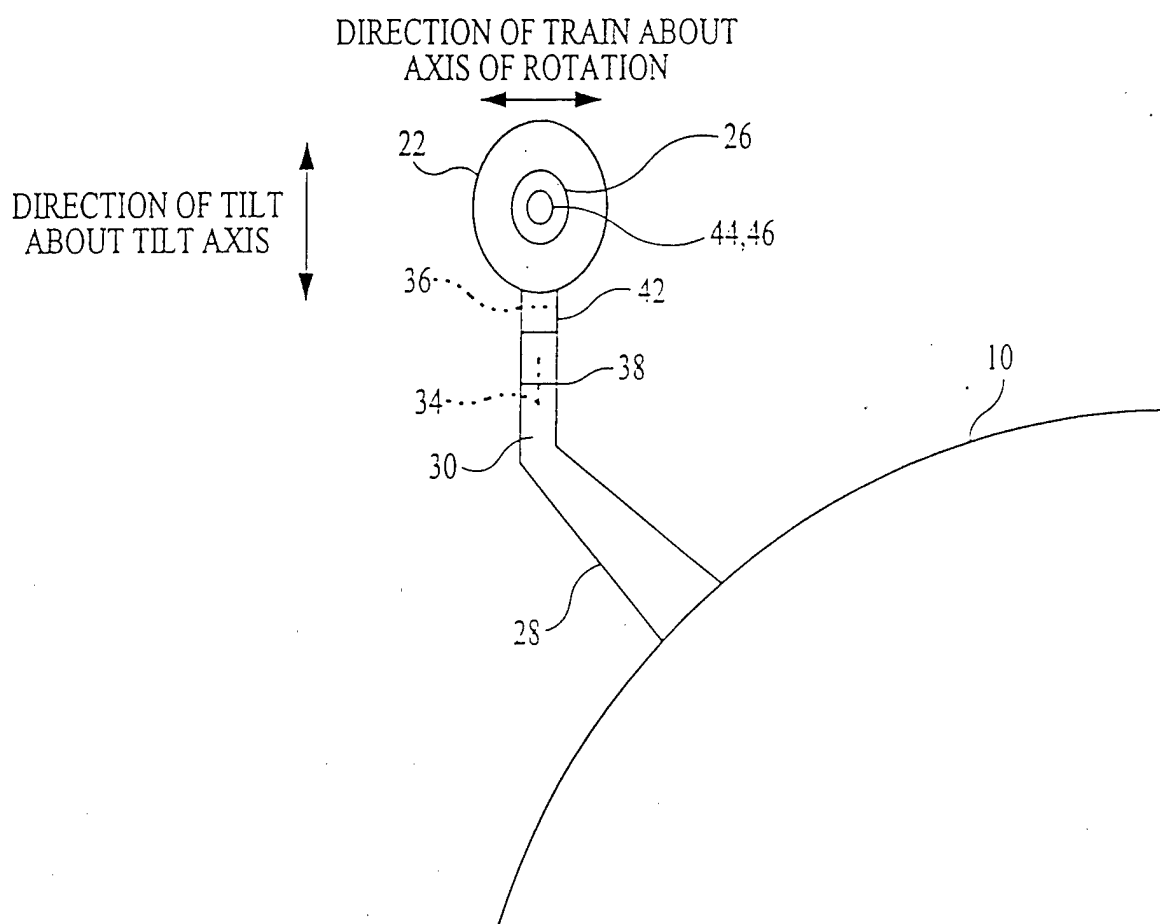
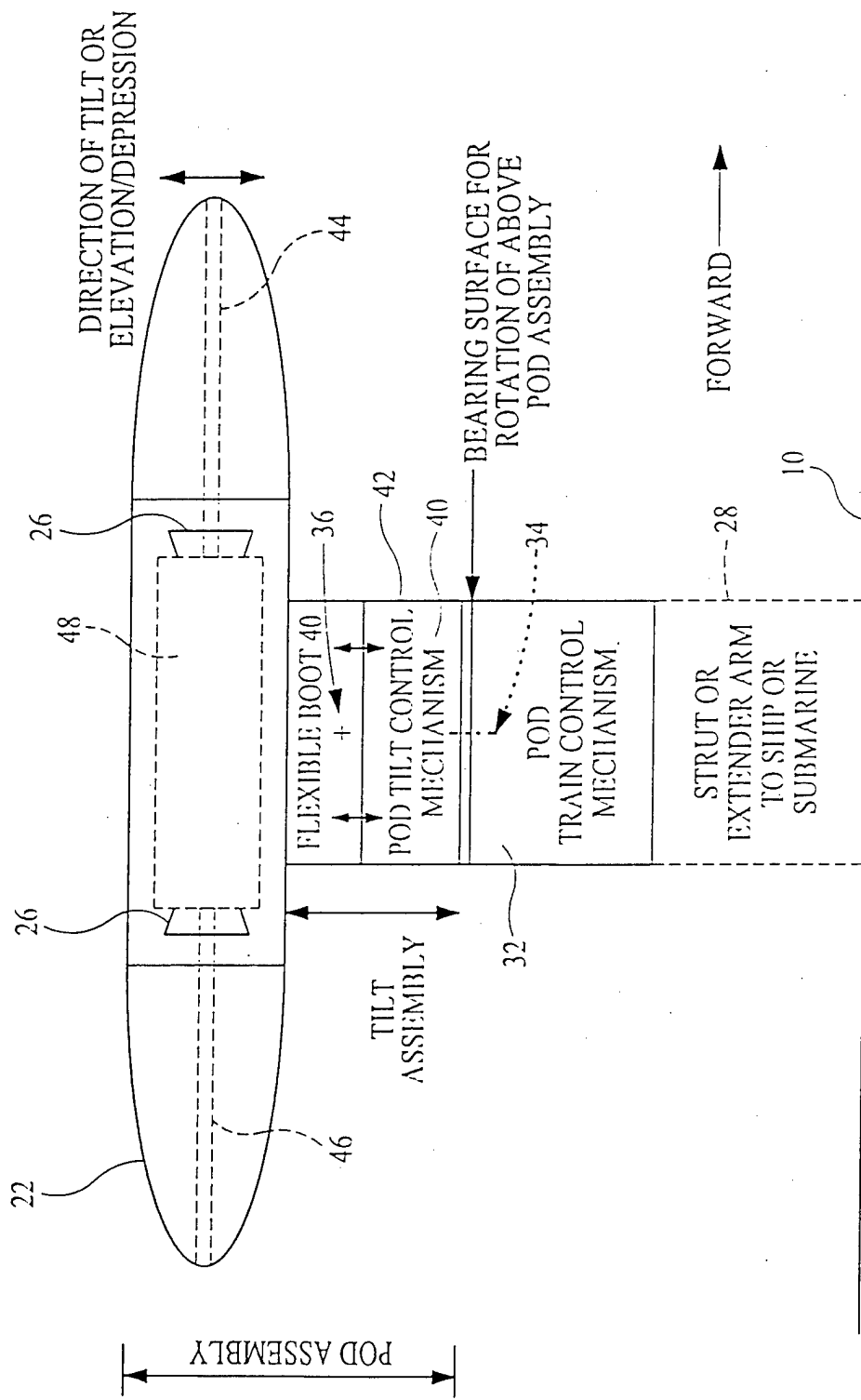


FIG. 3



HULL OF HOST VESSEL

FIG. 4

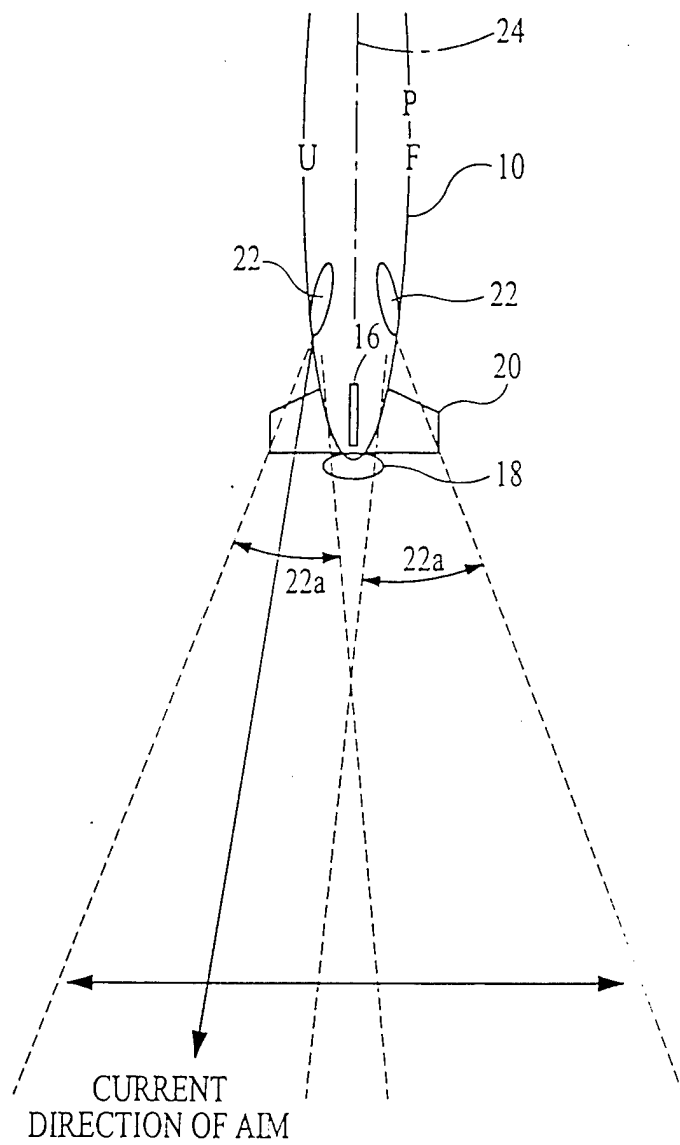


FIG. 5

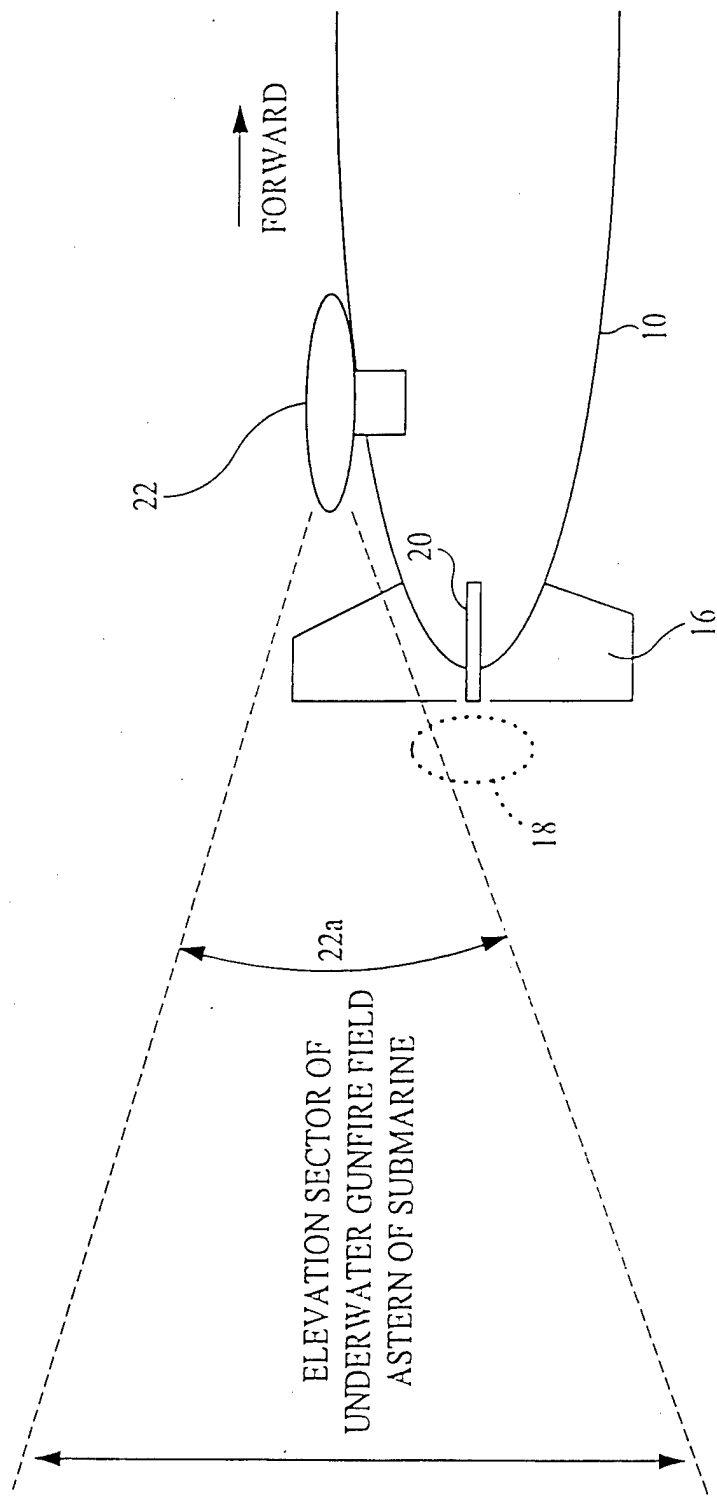


FIG. 6

AZIMUTH SECTOR OF UNDERWATER GUNFIRE FIELD

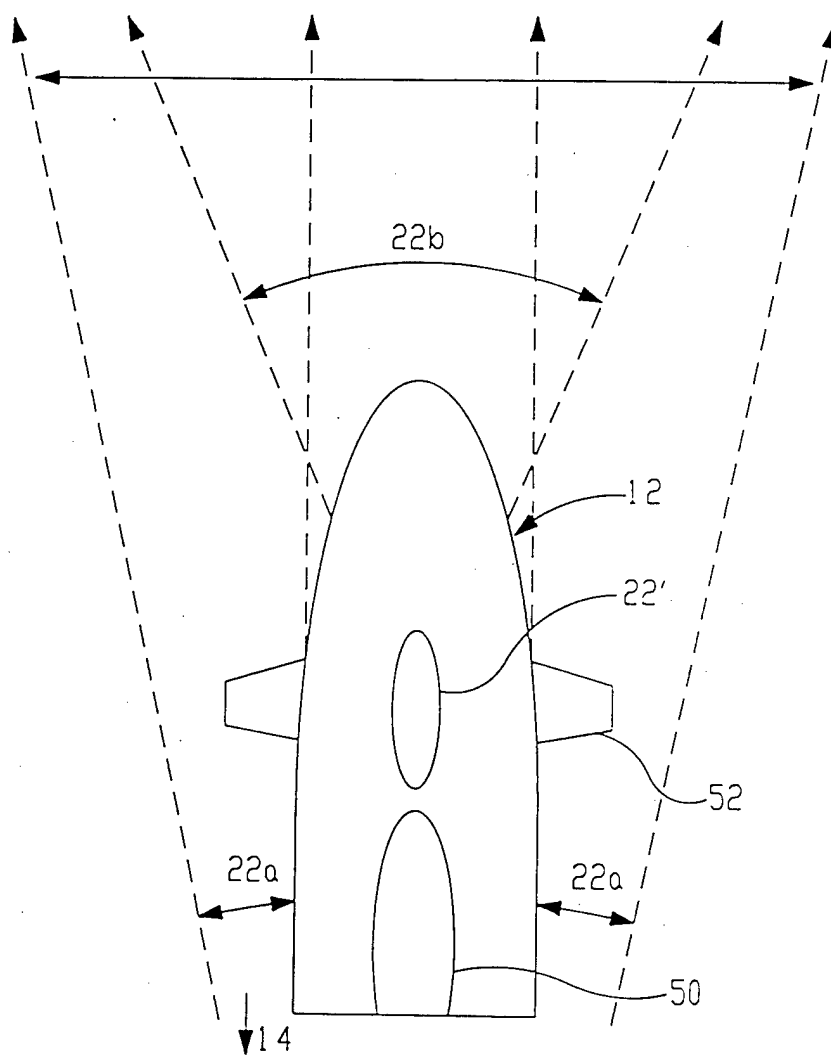


FIG. 7

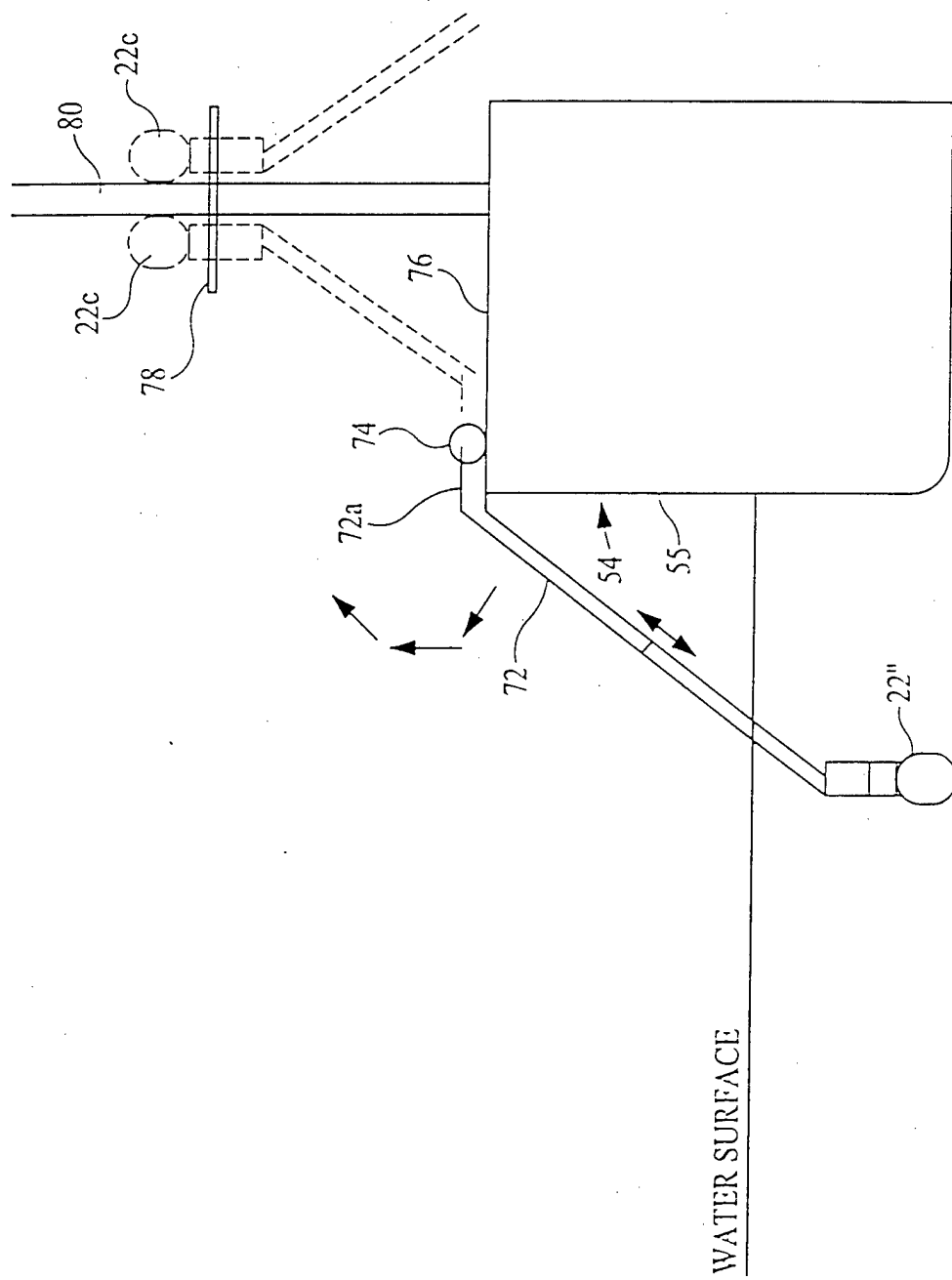


FIG. 8

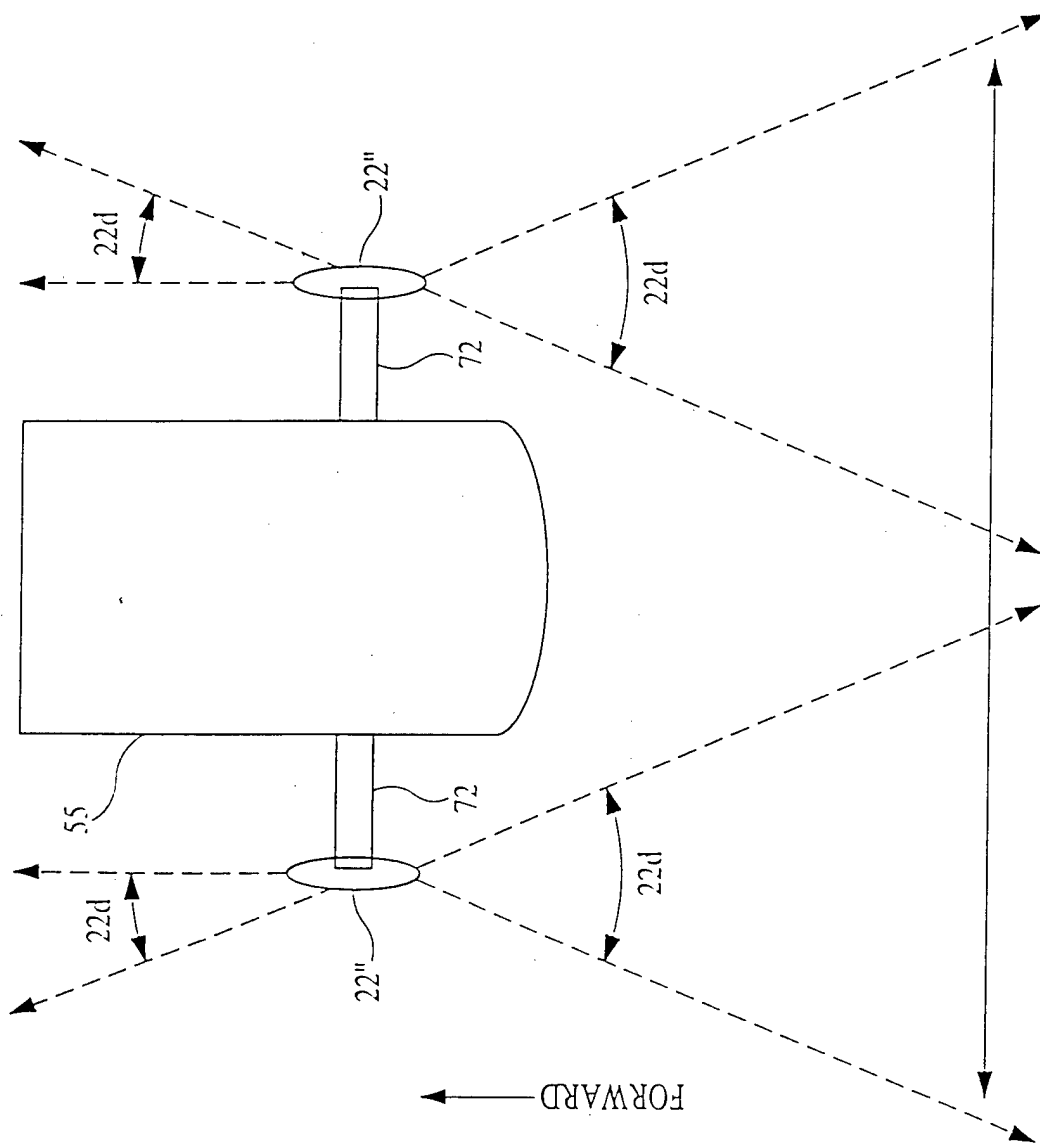


FIG. 9

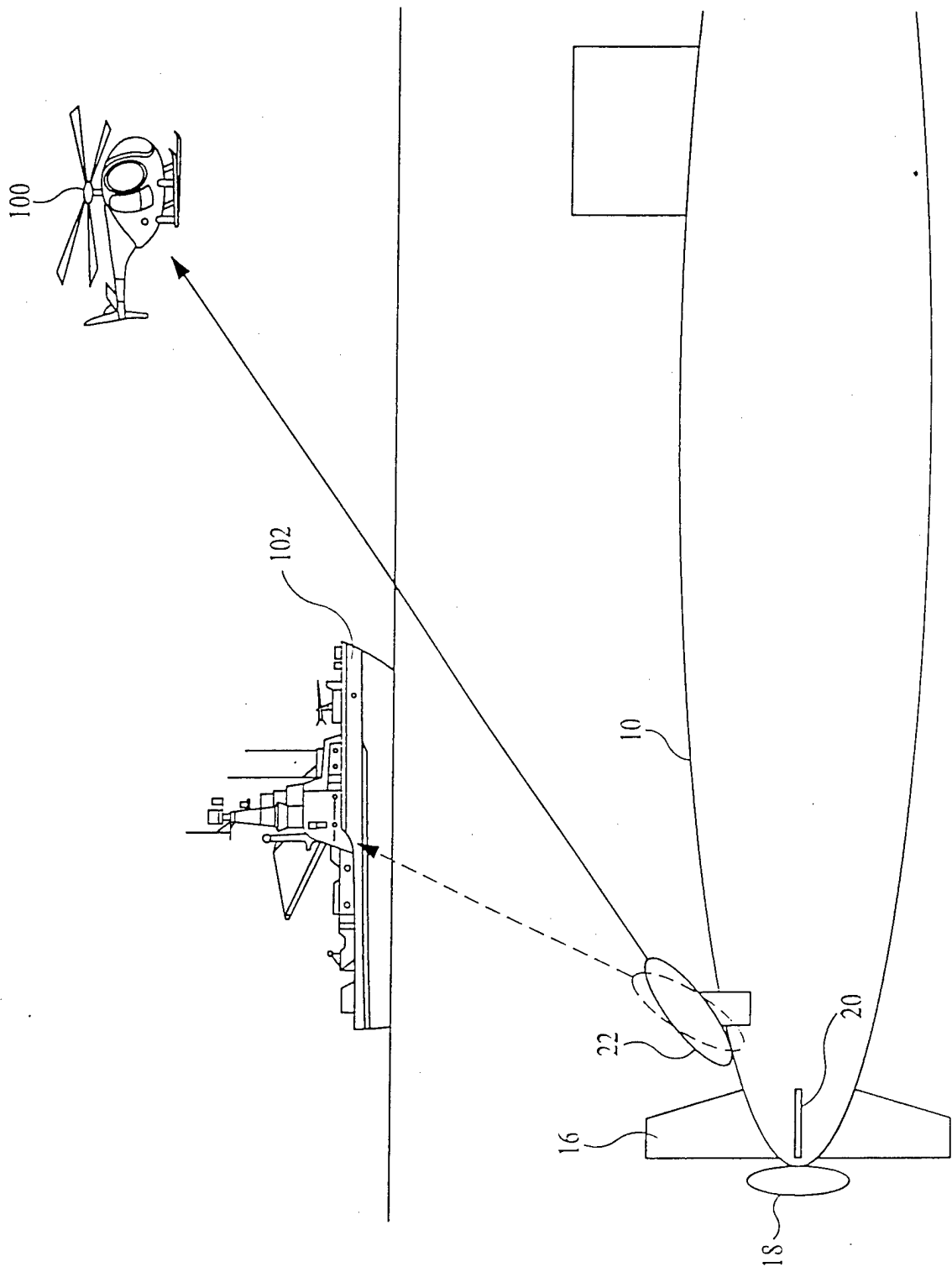


FIG. 10

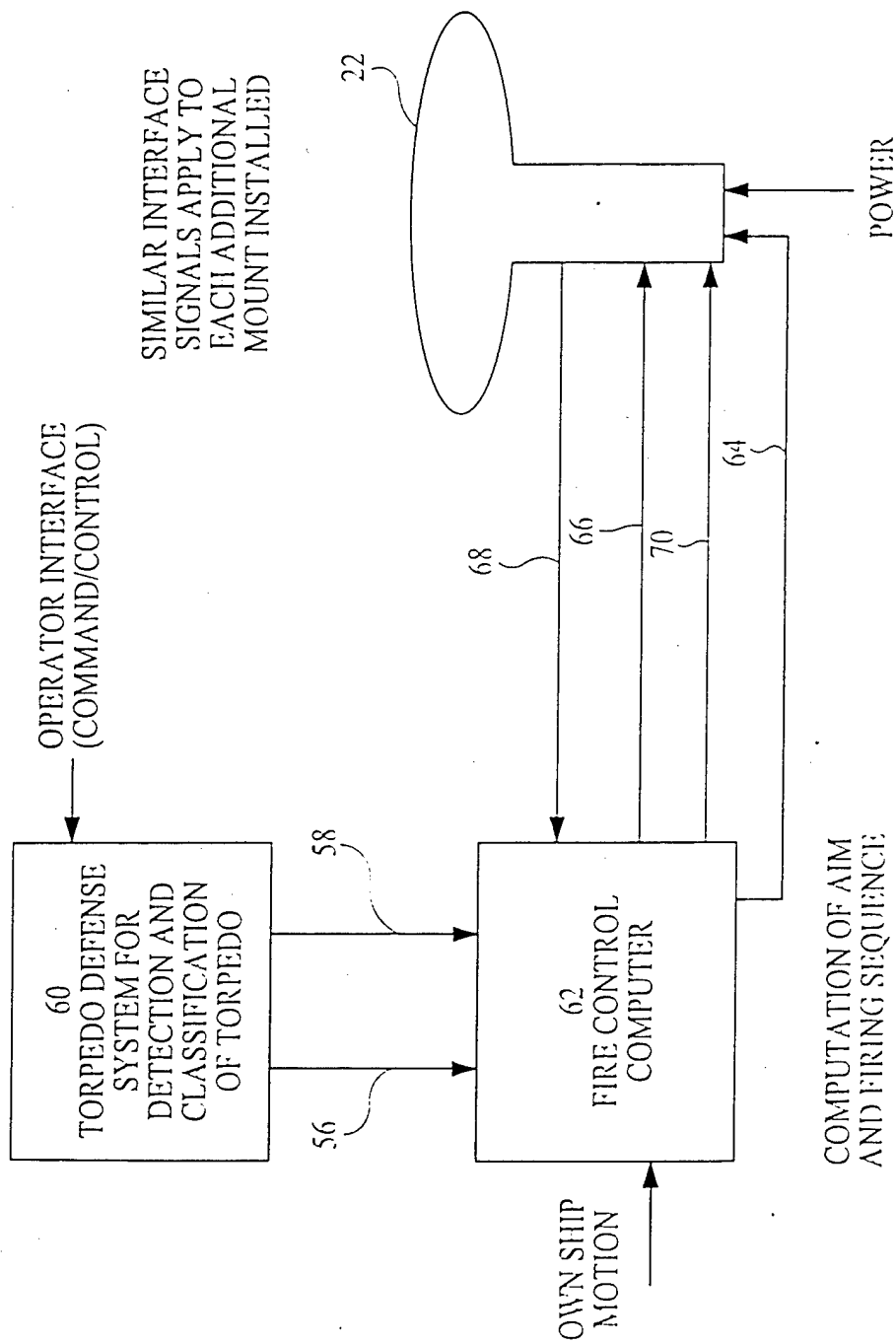


FIG. 11