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1 Navy Case No. 77366

2 ACTUATED RECOIL ABSORBING MOUNTING SYSTEM

3 FOR USE WITH AN UNDERWATER GUN

4 STATEMENT OF GOVERNMENT INTEREST

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

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10 BACKGROUND OF THE INVENTION

11 (1) Field Of The Invention

12 This invention relates to recoil absorbing mounts for
13 projectile launchers and in particular, to a recoil absorbing
14 mount using hydrodynamic added mass to decrease recoil velocities
15 and hydrodynamic damping to absorb recoil energy in an underwater
16 environment.

17 (2) Description Of The Prior Art

18 The development of underwater projectile launchers, such as
19 underwater guns which fire supercavitating bullets, requires that
20 the new projectile launchers be tested. The firing of projectile
21 launchers involving a high discharge energy results in a recoil
22 that may affect the accuracy or testing of the launcher. To
23 accurately test such projectile launchers and to implement such
24 devices, the projectile launcher must be mounted in such a way

1 that the recoil from the high discharge energy is sufficiently
2 absorbed.

3 Some prior art recoil mounts used with guns include U.S.
4 Patent No. 2,817,233 to Dower, et al, U.S. Patent No. 2,729,975
5 to Hawthorne, et al, U.S. Patent No. 2,273,878 to Magrum, et al,
6 U.S. Patent No. 2,309,807 to Trotter, and U.S. Patent No.
7 2,333,398 to Trotter, et al. These patents do not, however,
8 disclose a simple device that effectively absorbs recoil from an
9 underwater high discharge energy gun, such as by providing added
10 mass to the gun. Inventions using added mass plates are,
11 however, known in the art. None of the prior art discloses a
12 recoil absorbing mount having an actuator used with an underwater
13 projectile launcher in an underwater environment.

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SUMMARY OF THE INVENTION

16 Accordingly, one object of the present invention is to
17 provide a recoil absorbing mounting system that provides
18 hydrodynamic added mass to the projectile launcher absorbing
19 recoil energy. A further object of the present invention is to
20 provide a recoil absorbing mounting system that can be used in an
21 underwater environment with an underwater projectile launcher by
22 providing hydrodynamic added mass to the projectile launcher. A
23 further object of the present invention is to provide a recoil
24 absorbing mounting system that combines added mass recoil

1 absorption with an actuator for repositioning the projectile
2 launcher after firing.

3 The present invention features a recoil absorbing mounting
4 system that includes a projectile launcher frame for supporting
5 the projectile launcher and for moving in a substantially linear
6 direction, and at least one recoil plate coupled to the
7 projectile launcher frame. The recoil plate provides
8 hydrodynamic added mass and damping to the projectile launcher
9 frame and projectile launcher, reducing recoil velocities and
10 absorbing the recoil energy during launching of a projectile.

11 According to a preferred embodiment, the recoil absorbing
12 mounting system includes at least one launcher frame support, for
13 slideably supporting the projectile launcher frame and allowing
14 movement in a substantially linear direction. The recoil
15 absorbing mounting system further includes at least one actuator
16 coupled between the projectile launcher frame and the launcher
17 frame support. The actuator applies a substantially linear force
18 to the projectile launcher frame, for repositioning the
19 projectile launcher frame, the projectile launcher and the recoil
20 plate after launching the projectile. According to different
21 embodiments, the actuator includes, but is not limited to, a
22 hydraulic actuator, a pneumatic actuator and an electrical
23 actuator.

1 The projectile launcher frame includes a gun clamp or other
2 suitable connection for rigidly supporting the projectile
3 launcher, and a second end rigidly supporting the firing chamber
4 of the projectile launcher. According to one embodiment, the
5 recoil plate is coupled at the second end of the projectile
6 launcher frame behind the muzzle of the projectile launcher.
7 According to an alternative embodiment, a plurality of recoil
8 plates are coupled, in a series, to the projectile launcher frame
9 for further increasing the hydrodynamic added mass and damping.

10 According to an alternative embodiment, the recoil absorbing
11 mounting system includes at least one roller disposed between the
12 launcher frame support and the projectile launcher frame, to
13 facilitate the substantially linear motion of the projectile
14 launcher frame with respect to the launcher frame support.

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BRIEF DESCRIPTION OF THE DRAWINGS

17 These and other features and advantages of the present
18 invention will be better understood in view of the following
19 description of the invention taken together with the drawings
20 wherein:

21 FIG. 1 is a perspective view of a projectile launcher, a
22 projectile launcher frame and a recoil plate according to the
23 prior art;

1 FIG. 2 is a side view of the recoil absorbing mounting
2 system according to the present invention; and

3 FIG. 3 is a perspective view of a projectile launcher frame,
4 projectile launcher, recoil plates, and support according to
5 another embodiment of the present invention.

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DESCRIPTION OF THE PREFERRED EMBODIMENT

8 A recoil absorbing mounting system 10, FIG. 1, is used to
9 mount an underwater projectile launcher 12 and uses hydrodynamic
10 added or virtual mass recoil absorption to absorb recoil energy
11 and to reduce recoil velocity from a projectile launcher 12. The
12 recoil absorbing mounting system 10 is preferably used in an
13 underwater environment with an underwater projectile launcher 12.
14 One type of projectile launcher 12 includes an underwater gun
15 that fires supercavitating bullets underwater and has a high
16 discharge energy. However, the present invention contemplates
17 using the concept of added (or virtual) mass recoil absorption in
18 combination with an actuator mechanism, described in greater
19 detail below, with various types of projectile launchers or guns.

20 The recoil absorbing mount 10 includes a projectile launcher
21 frame 14, for supporting the projectile launcher 12 while the
22 projectile launcher 12 is fired, and one or more recoil plates
23 18. The recoil plate 18 is coupled to the projectile launcher
24 frame 14 to provide added or virtual mass to the projectile

1 launcher frame 14 and the projectile launcher 12 in order to
2 reduce recoil velocities and to absorb recoil energy during
3 launching of a projectile. The recoil plate 18 is surrounded by
4 ambient water and provides hydrodynamic added mass caused by the
5 accelerating water and hydrodynamic damping by shedding vortices
6 in the immediate vicinity of the recoil plate 18 during firing of
7 the projectile launcher 12.

8 The projectile launcher frame 14 includes a first end 26 and
9 a second end 28. The first end 26 of the projectile launcher
10 frame 14 preferably supports a muzzle 30 of the projectile
11 launcher 12 by a system of one or more clamps or other
12 connections. The second end 28 of the projectile launcher frame
13 14 supports a firing chamber 32 of the projectile launcher 12.
14 According to one preferred embodiment, the recoil plate 18 is
15 mounted behind the firing chamber 32 on the projectile launcher
16 frame 14. The high discharge energy caused by firing the
17 projectile launcher 12 is, therefore, effectively absorbed by the
18 hydrodynamic damping of the recoil plate 18, while recoil
19 velocities are reduced by the load of accelerating the
20 hydrodynamic added mass in an underwater environment. The
21 present invention also contemplates mounting the recoil plate 18
22 at any point along the projectile launcher frame 14 or on the
23 projectile launcher 12 itself.

1 According to an exemplary embodiment, the projectile
2 launcher frame 14 rigidly supports the projectile launcher, such
3 as by a gun clamp or other means known in the art.

4 According to one embodiment of the present invention, the
5 projectile launcher frame 14, FIG. 2, is slideably supported by
6 one or more launcher frame supports 16. For example, the
7 launcher frame supports 16 support the projectile launcher frame
8 14 in a way that allows the projectile launcher frame 14 to move
9 in a substantially linear direction indicated by arrow 2 when the
10 projectile launcher 12 is fired. According to one embodiment,
11 each support 16 is mounted to a turret or other suitable fixture
12 substantially rigidly attached to the launch vessel, platform or
13 test facility. Four supports 16 are shown in FIG. 2, but the
14 present invention contemplates any number of supports 16 to
15 slideably support the projectile launcher frame 14 and allow
16 movement in a substantially linear direction. One or more
17 rollers 34 are disposed between the projectile launcher frame 14
18 and the launcher frame supports 16 facilitating this linear
19 motion. The present invention further contemplates any other
20 type of mechanical expedient that reduces friction and
21 facilitates linear motion.

22 Also, according to the embodiment, the recoil absorbing
23 mount 10 further includes one or more actuators 24 coupled
24 between the projectile launcher frame 14 and one of the launcher

1 frame supports 16 by at least one link 25. The actuators 24 act
2 to reposition the projectile launcher frame 14 and projectile
3 launcher 12 after the projectile launcher 12 has been fired, for
4 example, by providing a linear force to the projectile launcher
5 frame 14. According to various embodiments, the actuator 24
6 includes hydraulic actuators, pneumatic actuators or electrical
7 actuators. Hydraulic and pneumatic actuators will provide
8 additional damping to projectile launcher frame 14 and projectile
9 launcher 12 during firing.

10 According to another embodiment, the recoil absorbing
11 mounting system 10, FIG. 3, includes a plurality of recoil plates
12 18a-18c mounted in series along the projectile launcher frame 14
13 to increase the effective hydrodynamic added or virtual mass.
14 The recoil absorbing mounting system according to the present
15 invention uses the added or virtual mass of one or more plates to
16 absorb recoil energy from a high discharge energy projectile
17 launcher. Using the added mass recoil absorption technique
18 provides a simple recoil absorbing mounting system that is
19 particularly effective in an underwater environment.

20 In light of the above, it is therefore understood that
21 the invention may be
22 practiced otherwise than as specifically described.

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ACTUATED RECOIL ABSORBING MOUNTING SYSTEM

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FOR USE WITH AN UNDERWATER GUN

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ABSTRACT OF THE INVENTION

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8 An actuated recoil absorbing mounting system is used to
9 reduce recoil velocities and to absorb the recoil energy from an
10 underwater projectile launcher, such as a high discharge energy
11 underwater gun. The recoil absorbing mounting system includes a
12 projectile launcher frame that supports the projectile launcher
13 during firing. The projectile launcher frame is slideably
14 supported by one or more launcher frame supports to allow
15 movement substantially in a linear direction. One or more recoil
16 plates are coupled to the underwater projectile launcher frame to
17 provide hydrodynamic added or virtual mass and damping to the
18 projectile launcher frame and projectile launcher. The recoil
19 absorbing mounting system further includes one or more actuators
20 for repositioning or returning the projectile launcher frame and
projectile launcher to an original position after firing.

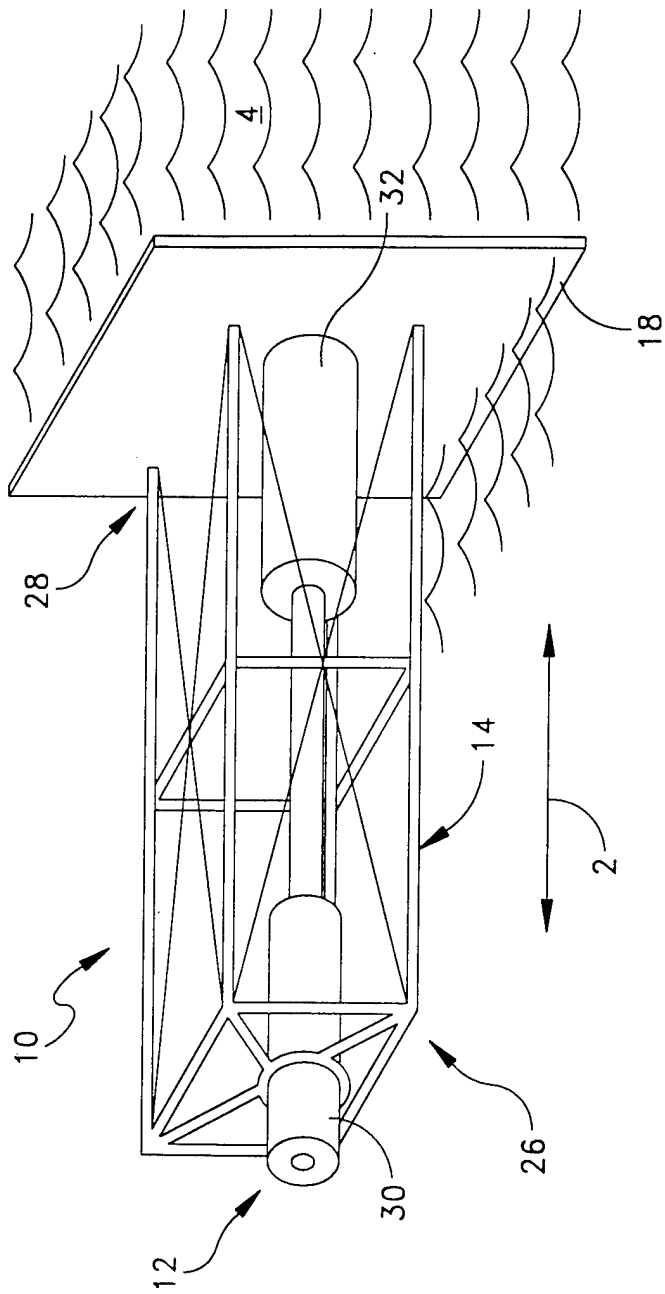


FIG. 1
(PRIOR ART)

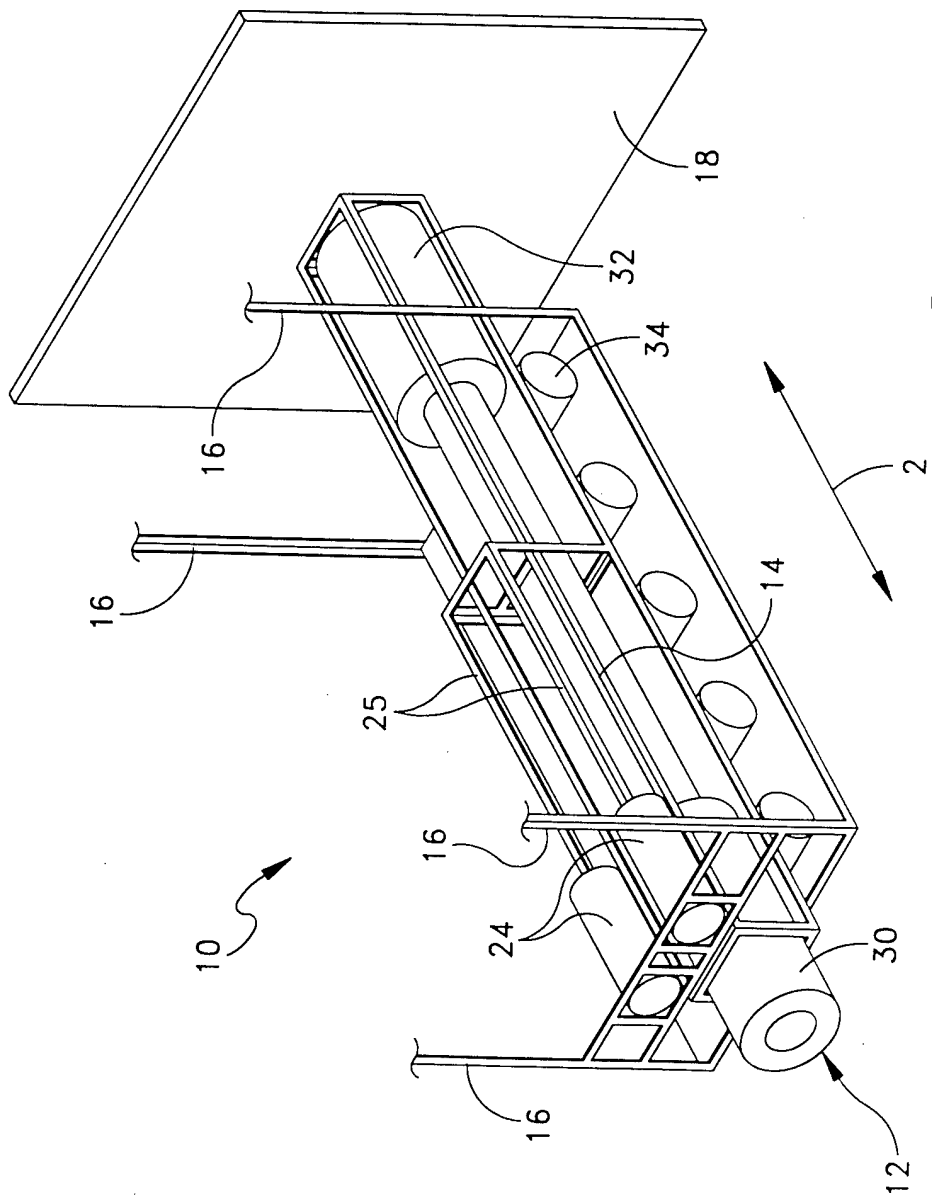


FIG. 2

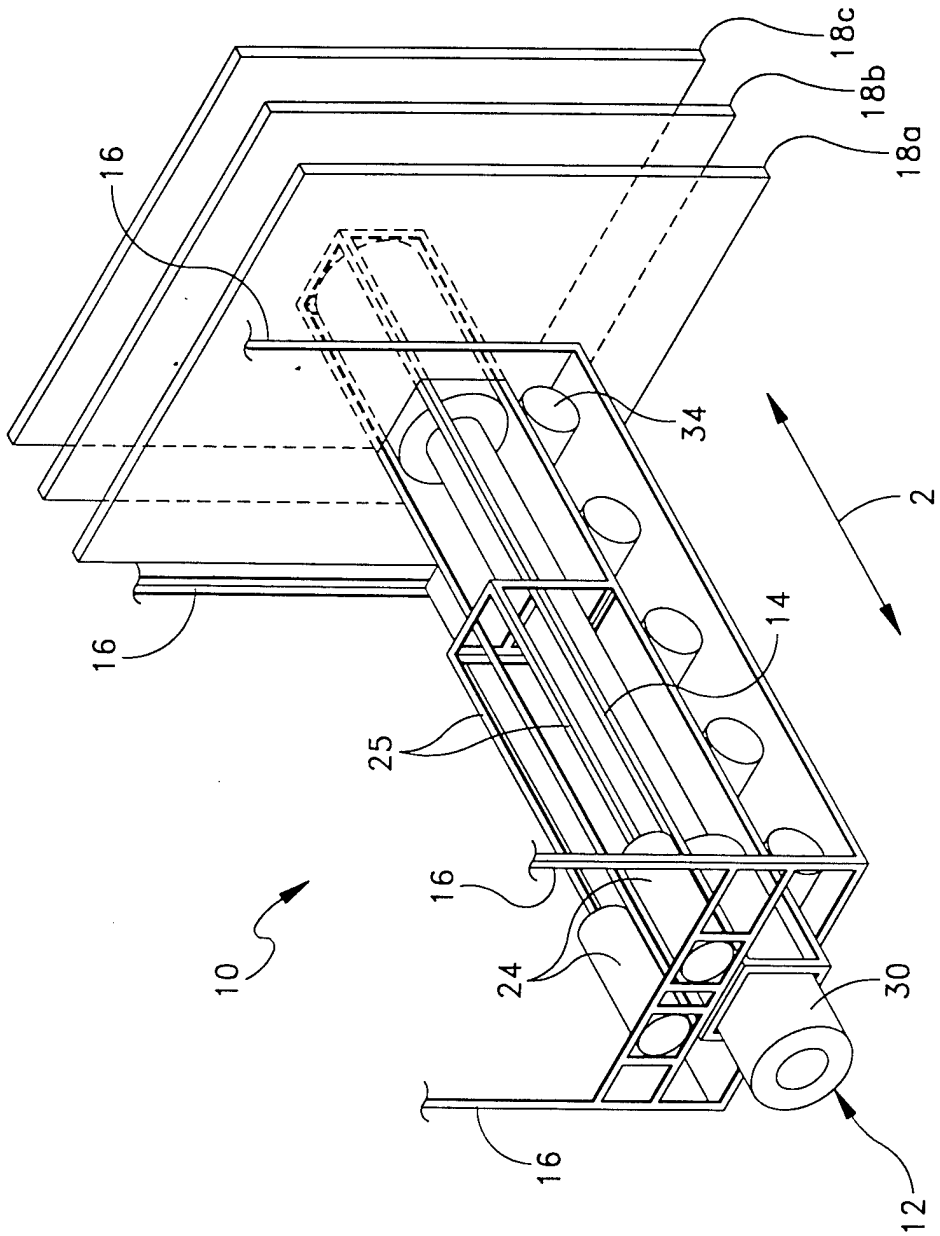


FIG. 3